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Forthcoming Events.

SEPTEMBER 27-OCTOBER 1.

American Foundrymen's Association:—International Congress at Detroit, U.S.A.

OCTOBER 4-9.

Motor Cycle and Cycle Exhibition at the Olympia, London, W.

Institute of British Foundrymen.

OCTOBER 2.

Lancashire Branch:—First meeting of the session at Manchester. "Notes on Foundry Progress," Paper by S. G. Smith.

SEPTEMBER 25.

Newcastle Branch:—First meeting of the session at Newcastle. Presidential address by E. Wood, B.Sc.

East Midlands Branch:—First meeting of the session at Loughborough. "A Comparison of White Heart and Black Heart Malleable Cast-Iron," Paper by A. E. Peace.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.

Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

British and German Foundry Industrial Organisations Compared.

One of the most important developments in European business circles during the last few years is the resuscitation of the German cartels for co-operative buying and selling. It is considered problematic whether these are of real use to the industries they are designed to serve, because their very power is liable to involve them in politics, with questionable benefit. The recent meeting of the German Foundry Owners' Association showed them to possess the widest activities. *Inter alia*, they have associated with them scrap, coke, and pig-iron buying companies, price-fixing groups by the institution of a unified costing system. In addition, they own their own newspaper and exhibition organisations, labour, research and statistical departments. Practically all these activities are covered in Great Britain by various societies and associations, except that of co-operative buying. Additionally, one could almost include the fixing of selling prices if one or two agreements were torn up which only affect sections of the industry. Another activity only partially covered in Great Britain is the collection of statistics, but progress is being made in several directions, and on the publication of the Census of Production, figures will be given, the examination of which will indicate those which are of paramount interest and are worthy of private collection by the industry. As to research, exhibitions, and the technical Press, British effort compares favourably with the German. The final factor, that of co-operative buying, we doubt whether it would show any real advantage. Distances being so much shorter in Great Britain, no real difficulty is imposed upon the buyer in obtaining an intimate knowledge of the availability and ruling prices of essential raw materials.

Where it is felt a maximum benefit could be derived is by the equitable fixing of selling prices for castings. Attempts have been made from time to time to prepare a price list, but a close scrutiny of the proposition shows it to be futile. A modification of the design, even but slightly, is an excuse for a price-cutting competition. The only fair means for the establishment of a selling price is the practical working by sections or districts of a properly thought-out costing system to be periodically inspected and revised by a mutually-appointed auditor. The problem of the last man to start up in business for himself with perhaps only £7 a week overhead expenses (an actual case) will have to be met in the future by the practical adaptation of the slogan—*Foundrymen—Machine Your Own Castings.* The engineers are becoming more and more assemblers of finished parts, and the foundrymen who are in a position to supply machined castings will be in a better position to compete.

The idea of attaching a foundry to a machine shop is the wrong way of tackling the problem, but the reverse is definitely a commendable and profit-producing procedure.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Centrifugally-Cast Bronze Gears.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Apropos of your article by Mr. F. W. Rowe, "Bronze Worm Gear Blanks Produced by Centrifugal Casting," in your issue of September 4, may I make a few observations based on modern methods in the United States of America. It has been my privilege over an extended period of years to cast and cut perhaps as many worm gears as other individual, and it is always a matter of interest to note the development of this particularly difficult gear. Many failures have from time to time been made in various quarters due to a lack of proper consideration of the variables that enter into the development of a gear wherein the peculiar propensities of the helix are inherent.

It is immediately clear that the thoughtful person will endeavour to eliminate to the utmost extent the sliding action and approach as nearly as possible a rolling condition, and much has been accomplished in this respect during recent years. Extraordinarily high efficiencies have been obtained, and so to-day we find that, ratio for ratio, a well-designed and well-made worm-gear set compares very favourably with other available speed reducers.

However, much has had to be done in order to reach the present high standard, and having to consider a semi-sliding condition, not the least difficulty has been in obtaining a suitable gear-bronze wherewith the lowest co-efficient of friction is obtained.

Copper-tin alloys have in a general way always seemed to offer the best anti-friction properties, and most generally have been adopted. A copper-aluminium bronze essentially 90 per cent. Cu 10 per cent. Al has in some instances been used. From the writer's experience a higher co-efficient of friction seems inherent to this material, and whilst he has made many thousands of gears for one prominent manufacturer from this alloy, he is only partial to it where ultimate strength is an essential. In this respect the copper-aluminium bronze is far superior to the copper-tin alloys.

This point of ultimate strength is of considerable value under certain conditions at present found by some motor manufacturers under present-day tendencies to lower vehicles. Road wheels are frequently of smaller diameters, and road clearance must be maintained.

The high unit-pressures permissible in modern worm gearing have led to smaller gears, and so the road clearance has in some cases been maintained. In so far as the differential is usually fitted inside the worm wheel, and as a certain inner diameter must be maintained to accomplish this object, the result has in some cases been a rather frail wall to the gear. The value of aluminium-bronzes in such instances, with its high tensile strength, must be obvious. As, however, many people have not been satisfied as to the anti-friction properties of the aluminium bronzes, the result has been many experiments to improve the ultimate strength of copper-tin bronzes, the anti-friction values of which are universally recognised. Chilling, first by ring chills and later by complete dies, and also centrifugal castings have been tried.

Centrifugal castings have been made under varying pressures, and whilst the writer has not found the pressure to be used at all critical, excellent results have been obtained by this method. Die castings have also produced very excellent results when properly made. The size of the chills, the pouring temperature, and a suitable coating for the dies have all been points to be deeply considered. Providing the chilling effect is sufficient to drive completely through the section of the casting without tapering off towards the centre the ideal condition in this process is obtained, and micro-photographs and physical tests will exhibit a very excellent gear, comparing favourably with anything the writer has seen from the centrifugal process.

In centrifugal castings one must guard carefully against a tendency for the metal to freeze in layers, like a spiral spring or lathe scroll, and further, the centrifugal effect has a tendency towards erosion of the inner refractory core. This remark in particular applies to a gear of which the inner periphery is not an unbroken circle, but is fitted with lugs, etc., for purposes of attaching the differential. Again, the centrifugal effect throws the heavier material to the outside and the dirt to the inside periphery. This in itself is an excellent condition, as it does ensure the best and cleanest material where the load-carrying teeth are to be cut, but frequently it has proved difficult to obtain risers capable of carrying off the dirt from the inner periphery, and not always has the casting been particularly clean in this respect.

It has therefore seemed to be the consensus of opinion of American manufacturers that no appreciable difference in ultimate strength has been obtained between centrifugal and semi-permanent mould castings, so that the semi-permanent mould type has been practically universally adopted, as offering an extremely uniform and high-grade material whilst presenting the minimum of complications and expense, as very little is necessary in the way of permanent equipment as compared to the costly rigging necessary to obtain suitable machinery for whirling the castings under the centrifugal process.

The most favoured alloy in the United States to-day is essentially as follows:—Tin, 11.0; lead, 0.25; phosphorus, 0.25 per cent., and balance, copper. This is the S.A.E. specification 65, and by the semi-permanent mould process the following physical properties are being regularly obtained in volume production by at least three manufacturers:—Ultimate tensile, 20 to 23 tons; yield point, 13 to 15 tons; elongation, 6 to 10 per cent.; and Brinell hardness (500 kilos.), 90 to 120. Some development has been made in the introduction of nickel in small quantities further to improve the ultimate strength, and one prominent manufacturer allows the foundries to use their own discretion regarding its use up to a certain point.

One manufacturer has its gear blanks supplied with the teeth rough cast in, but this complicates matters in the foundry, entails additional cost of the casting, and again means that the gear cutter must waste some time in picking up the tooth. Also some criticism has been offered due to a tendency for hobs to rise at times and follow the eccentricity of the casting, resulting in a gear "out of round," so that for the moment casting in the teeth has not found too many supporters, especially as a good market is available for such high-grade bronze chippings.

Yours, etc.,

C. J. FITZPATRICK.

18, St. Andrew's Mansions,
Dorset Street, London, W.1.
September 20.

Chemistry of the Cupola.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your issue of September 9, your correspondent, Mr. F. W. Neville, makes some interesting suggestions regarding the precipitation of carbon from CO in the upper and cooler portions of a cupola.

If, as suggested, the carbon thus precipitated is blown off from the top of the charge the efficiency of the cupola will be reduced appreciably. It is, however, largely deposited on the surface of the iron, and when samples of the latter have been removed from the upper part of the charge, either during or just after a run, the superficial coating, when present, has usually been found to be moderately coherent, and therefore not likely to be easily detached. We do not know of any cupola gas analysis which gives a value for "carbon in suspension," and quite agree with Mr. Neville that the question is of considerable importance and well worth investigation. The possibility of loss of carbon in this way had not occurred to us at the time the Paper in question was written, and we should like to thank Mr. Neville for drawing attention to it.

Yours, etc.,

F. C. THOMPSON.
M. L. BECKER.

Department of Metallurgy,
The Victoria University of Manchester.
September 20, 1926.

Mineral Resources of the Far East.*

By C. K. Leith.

At the present time the countries of the Far East yield only an insignificant proportion of the world's total of the essential commercial minerals—for example, about 5 per cent. of the copper, 1 per cent. of the iron ore, 5 per cent. of the coal, and 3 per cent. of the oil. Only in a few of the less essential mineral commodities are the proportions larger. In contrast, the countries bordering or tributary to the North Atlantic now furnish the vastly larger part of the world's requirements in essential minerals—90 per cent. of the coal, 98 per cent. of the iron ore, 65 per cent. of the copper, and 90 per cent. of the oil. There is a tendency to attribute this situation to the mere lack of exploration in the Far East, and to assume that when this has reached a stage comparable with that of the North Atlantic countries the production of essential minerals will be more or less equalised. But a survey of the facts proves this assumption to have but a slender basis. In fact, the conclusion seems inevitable that (with certain exceptions to be noted) the present small scale of mineral production in the Far East is not a temporary but a permanent condition, being due to the absence of mineral resources in quantity or grade or distribution suitable for effective use. This conclusion has been repeatedly reached by competent investigators. Nevertheless, the prevailing popular notion is that the countries of the Far East, especially China, contain fabulously rich mineral wealth.

In the discussion of this problem confusion may arise unless a scale of comparison is indicated. There are in the Far East many units of mineral resources which seem large in an absolute sense, but which on a world scale must be assigned to a subordinate position. Also, the world scale used for comparison should be that of recent years, for the reason that the demand for mineral resources has so multiplied during the last quarter of a century that it can now be satisfied only by a relatively small number of mineral districts of exceptional size. The result is a marked concentration of the mineral industry in a few places. While in the aggregate other districts may contain vast quantities of minerals, they are so small individually, or so scattered, or are of such a low grade, or involve such high mining costs, that they play only a subordinate part in the satisfaction of present world demands. Much remains to be learned about the world's ultimate resources, but exploration has gone far enough to disclose many salient features of the mineral geography of the future, from which can be gleaned some of the essential facts of the mineral resource situation of the Far East.

Iron Ore and Coal in China.

In the Pacific region of the Far East the most talked of and significant of the resources to be considered are the coal and iron ore of China. The coal resources, though but slightly developed, are very large, some estimates indicating that they form nearly a quarter of the world's supply. Some of the largest reserves, however, are in remote regions which will be inaccessible for commercial development for a long time to come. The only coking coal available in large quantities for metallurgical purposes is in Chihli, Fengtien, and Shansi in the north, and Kiangsi in the south.

The iron-ore reserves of China, according to latest estimates, aggregate 950,000,000 tons, a figure which represents about one-fifth of the reserves of iron ore of present commercial grade in the United States. An analysis of the estimates, however, shows that much of this tonnage may not be considered workable under present conditions, due to inferior grade or remoteness from existing lines of communication, and should not be included in any comparison that is made with reserves of commercial grade existing elsewhere. For example, it includes low-grade, banded hematites and magnetites in Manchuria and north-eastern Chihli, running 30 to 36 per cent. in iron, which must be concentrated before smelting. The feasibility of effecting sufficiently cheap concentration is still to be proved. In the United States and other parts of the world there are large quantities of ores of this class which have not yet been able to compete with the ores concentrated by nature, and which are not included in estimates of commercial reserves. The inclusion of these low-grade ores in the commonly quoted figures of China's iron-ore resources but emphasises the real poverty of China in ores of present commercial value.

The immediately available Chinese ores of commercial grade, not requiring concentration, and not handicapped by remoteness from transportation, are estimated at about 100,000,000 tons, about three-fourths of which are along the Yangtse river, and one-fourth in the Hsuan-Lung region north-west of Peking. The first-named group, which is well known, has been mined on a modern scale. It would supply the iron and steel plants of the United States for less than two years. The remaining reserves will not be able to compete commercially in the world's iron and steel business for a very long time. The present rate of Chinese iron-ore production is a million tons or less a year—less than 2 per cent. of that of the United States. Japan now controls commercially about 90 per cent. of the available reserves. Obviously, then, the reserves of iron ore now known to exist in China do not warrant the huge capital investment necessary to the building of a great iron and steel industry.

Much has been said about the probability of the existence of great undiscovered reserves of iron ore in China. The best Chinese iron ores are of a type which is hard and resistant to erosion, and therefore outcrop freely. It is true that native methods of smelting favoured the use of softer ores, and that the value of the harder ores was not recognised by the Chinese. Nevertheless, there are few records of actual "discovery," in the geographic sense, since China has been penetrated by foreigners. The chances, therefore, of adding to China's iron resources by further exploration are not promising.

Japan's Mineral Resources.

The Japanese empire is the chief consumer of iron and steel products in the Far East, but its known resources of iron ore are largely confined to one deposit, the Kamaishi Mine, in Riquchu province, with an estimated reserve of 35,000,000 tons. In various additional sources some of the Japanese estimates indicate the existence of 45,000,000 tons more, but this ore is widely scattered and much of it is of low grade. Domestic production has averaged 209,000 tons yearly for the last ten years, or less than half of 1 per cent. of that of the United States. Japan also has reserves in Korea, estimated at 4,000,000 tons, and from this source has imported slightly more than the domestic production. Japan's paucity of iron ore explains her activity in acquiring and developing the Yangtse deposits of China and her present attempts to concentrate the low-grade ores of Manchuria. Japan is better supplied with coal than with iron ore, but compared with the other principal industrial nations of the world she is very poorly off. She has exhausted a much larger proportion of her reserves than any other country, and her industrial future is correspondingly limited. For some years the Imperial Steel works have been supplied by mixing Japanese coal with Chinese coal. Much of the coke from Japanese coal is weak and porous. The reserve of coking coal is so small that there has been much discussion of a Government plan to electrify the iron works, in order to postpone its exhaustion.

Russian Far East.—The iron ore deposits of the Russian Far East aggregate hardly more than 5,000,000 tons, in scattered deposits. The only coal proved to be of good coking quality is in Sakhalin Island, where the fields are but little developed and good ports are scarce and ice-bound for several months of the year. Both iron ore and bituminous coalfields are insignificant in Indo-China. Siam has a few scattered undeveloped iron

* "Far Eastern Review."

ore deposits, but the known coal is mostly lignite. The Malay Peninsula and British Borneo contain some iron ore deposits, but they are only of local importance, the aggregate being not more than 25,000,000 tons.

East Indies.

The situation seems more promising, at first glance, in the Netherlands East Indies, particularly in the south-eastern part of Borneo and in the central part of Celebes. The iron ore in these regions constitutes one of the largest reserves yet known in the Far East; it is estimated at 800,000,000 tons, much of it within easy reach of the sea. But this ore is of the lateritic variety, like that of Cuba and of Surigao Province in the Philippines—a variety which, because of its content of nickel, chromium, high alumina, and moisture, has thus far presented certain metallurgical difficulties which have prevented its extensive use even in favourable locations. A furnace is now being built by a Dutch syndicate, in co-operation with the Government of the Netherlands East Indies. While there is coking coal in this region, the amount is so limited and of such a low grade that a study is being made of the possibility of electric smelting, as well as smelting with oil residue. There is reason to believe, however, that neither of these methods can be developed much beyond the point of supplying small local needs.

The Philippines contain important deposits of lateritic iron ore, estimated at 430,000,000 tons or more, principally in Surigao, on northern Mindanao. Lignitic coal is abundant, and bituminous coal less so. Coking coal exists in very limited quantities, principally in southern Mindanao. Any iron ore industry which may develop is not likely to supply more than local demands.

It appears highly improbable, then, that an iron and steel industry on the scale of Western Europe or the United States can develop in the Pacific region of the Far East. China, with the best supply of coking coal, does not have enough iron ore of present commercial grade, and the geographic separation of the best available coking coal and iron ore is a heavy handicap. Netherlands East Indies and the Philippines have large supplies of iron ore, but very limited supplies of coking coal. Neither the ore nor the coal is of the best grade. Japan, with the largest plant capacity, largest consumption, and the best organisation, lacks both coal and iron in sufficient quantities. The scattered supplies of coal and iron in all the other countries of the Far East are insignificant in comparison with the ones named. If all the coal and iron resources of the Pacific region were to be pooled under one operation, the total supplies would be adequate for a large industry; but there would still be heavy commercial handicaps due to the grade of the iron ore and to the wide geographical separation of the best available grades of ore and of coking coal, resulting probably in costs too high for successful competition with the other principal iron- and steel-producing nations of the world. Disregarding political boundaries, perhaps the best potential combination in the Pacific region would be between the iron ores of the Philippines and the Dutch East Indies on one hand, and the coking coal of the north-eastern provinces of China on the other—the whole under the management of the Japanese.

Indian Iron Ore and Coal Reserves.

There remains to consider the iron and coal resources of India. Here are large reserves of high-grade iron ore, estimated at upwards of one and one-half billion tons. These ores, though considerably less in quantity than the ores of the United States and Western Europe, are far the largest and best of the iron-ore reserves of the Far East. It is much less certain that there is an adequate supply of coke in India, notwithstanding large reserves of coal. A committee of the Indian Government, appointed in 1920, indicated the probable exhaustion of the coking coal within forty years, but more recent discoveries are said to have increased the known reserves. (Much of the coal is vitiated by high phosphorus and ash content.) Production of iron and steel is as yet on a small scale, but the capacity has increased faster than has local consumption, pointing to export to Western Europe as the natural outlet. Briefly, it may be said that the supplies of raw materials in India are adequate for the growth of a large iron and steel industry. The limiting factors are the small capacity for local consumption and the distance from the principal foreign markets. In the immediate future the mining industry will depend for growth mainly upon exportation, which is another way of saying that it will be dependent upon Western industrial centres.

It is sometimes argued that even if the quantity and quality of the resources in the Far East do not favour the development of an iron and steel industry on a profitable commercial basis, such a development might still be effected, at a cost, for political and military reasons. This argument fails to take into account the fact that such an industry involves huge capital outlays, for thousands of plants, not only those necessary for the primary conversion of the raw materials, but for the finishing and manufacturing necessary to put the iron and steel into the highly varied forms used by the ultimate consumer. The financial strain involved in going much beyond the output determined by normal commercial feasibility would test the resources of even the financially strongest countries of the world, and it is hardly to be expected that the financial resources of the Far Eastern countries will permit much building of this kind.

Important Firms Change Addresses.

The Wellman Smith Owen Engineering Corporation, Limited, Wellman Seaver Rolling Mill Company, Limited and The Wellman Bibby Company, Limited, have removed their Head Offices from Kingsway to Victoria Station House, Victoria Street, London, S.W.1. The telegraphic address is to be "Principium Sowest London," and the telephone number, Victoria 7752, 7753 and 7754.

The Sanderson Bibby Company, Limited, another member of this group, will also be housed at the new address, but has a separate telegraphic address—Electlocom, Sowest.

The British Drying and Heating Company, Limited, have removed from Abbey House to larger premises at 14, Waterloo Place, London, S.W.1. The new telephone number is Gerrard 4850, and the telegraphic address Britdriet, Piccy, London.

Publication Received.

Year Book, 1925.—Published by the Swedish Chamber of Commerce for the United Kingdom, 14, Trinity Square, E.C.3. For the foundry industry there are two reports on the Swedish iron and steel industry of an authoritative character.

THE ALFRETON IRONWORKS, Derbyshire, belonging to the Stanton Ironworks Company, Limited, have closed down for an indefinite period.

THE ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX is holding its third conference during the week-end, September 24-27, at Balliol College, Oxford. The Rt. Hon. the Viscount Burnham will speak at the opening dinner. Papers are to be given on various problems affecting the collection and distribution of information by experts, including Dr. de Vos Van Steenwijk of the League of Nations, and Mr. Kaiser of the Engineering Societies' Library (New York), who will speak on "Systematic Indexing."

MR. A. MCGLASHAN, the general manager of the shipyards of William Gray & Company, Limited, West Hartlepool, is retiring, after more than fifty years of active shipbuilding. Mr. McGlashan spent his early days with Clyde shipbuilding firms, and went to West Hartlepool 43 years ago, as chief draughtsman to Wm. Gray & Company, Limited, subsequently becoming general manager of the shipyards and a director of the company. Mr. McGlashan has been closely associated with the work of the Works and Conference Board of the Shipbuilders' Association. He is also a member of the Central Board of the Shipbuilders' Association, and is Chairman of the Tees and Hartlepools Shipbuilders' Association.

The Malleable-Iron Foundries of Thos. L. Hale (Tipton), Limited.

During recent years scientific research has been responsible for the introduction of radical changes into the founding industry. In no section of the industry, however, are the results of such changes more apparent than that devoted to malleable castings. The malleable-iron casting of to-day has little in common with its prototype of even a few years ago. It provides another instance of science coming to the aid of necessity. It is not merely that consumers have become more critical, but conditions have become more exacting, whilst the field of usefulness for the malleable casting has widely extended and is still extending. Manufacturing processes, however, have kept well in line with modern developments; indeed, such a high degree of perfection has been attained in production, that for many purposes the malleable-iron casting challenges seriously and successfully the stamping and drop forging. The tensile strength of the casting is within 6/8 tons of that of mild steel, whilst the best of such castings have an elongation of 9 per cent. The most important consideration, however, in favour of the malleable casting is that it can be cast practically to size, in some instances with not more than 5 per cent. of waste, so that subsequent machining is reduced to a minimum.

FIG. 1.—VIEW IN FOUNDRY; FURNACES AT LEFT AND IN REAR.

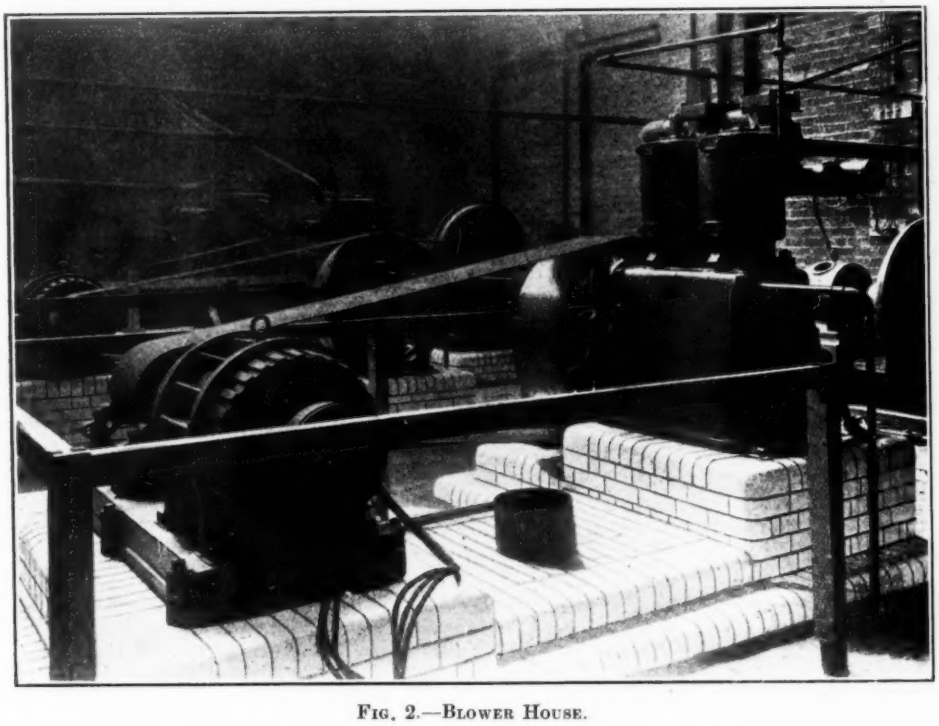


FIG. 2.—BLOWER HOUSE.

The Dudley Port Works of Messrs. Hale are

among the most modernly equipped, and, covering some 6 acres of ground, they are also among the largest in the kingdom devoted to the production of malleable castings.

The business had a very modest beginning some seventeen years ago, when a small foundry was laid down by the Brothers Hale, the enterprise being subsequently refloated as a limited liability company under its present title of T. L. Hale (Tipton), Limited. Mr. Thomas L. Hale and Mr. W. Edgar Hale were the original, and still are the sole, proprietors. From the outset the Company laid themselves out for a high quality of production, and they found a very ready market. Extensions were made from time to time to the foundry, and a further works was laid down at Tamworth. The buildings, however, were wholly unsuitable for a foundry of any magnitude, and the directors therefore wisely decided to lay down a new works on a site affording ample facilities for future extensions. The cost of such a works is a capital charge, whilst the conduct of the business in "rabbit-warren" premises entails a constant drain on revenue.

The site chosen is in Lower Church Lane, Dudley Port, and within 10 miles of Birmingham, with a canal basin and a considerable acreage available for future extensions. As previously stated, the works at present completed cover approximately 6 acres, of which the foundries occupy 3½ acres. Railway facilities were at first not available, but sidings have now been constructed at the works and connected up with the L.M. & S. Railway. This involved a considerable expenditure, as not only had the whole of the ground to be made up to works level, but Church Lane had to be bridged over.

The building is lofty and provided throughout with north lighting. The whole of the service mains—air, water, electric cables, etc.—are carried on the columns, thus leaving the floor entirely free from obstruction.

FIG. 3.—ANNEALING BAY.

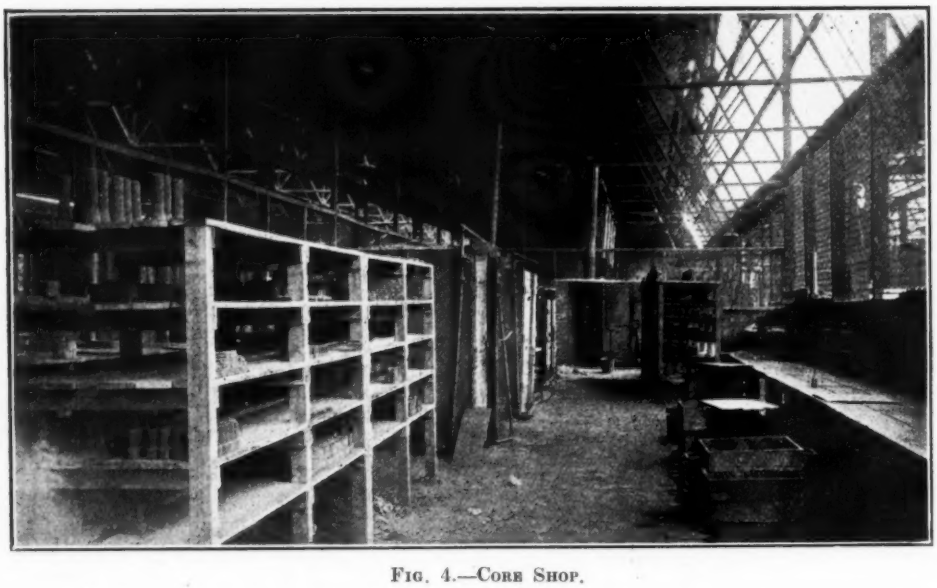


FIG. 4.—CORE SHOP.

The melting plant comprises 5 furnaces, each of 5 tons per hour capacity; these are arranged in two groups of three and two respectively, the object being to simplify the simultaneous production of different grades of iron. Each group of furnaces is served by a 15-cwt. electric hoist.

The foundry is covered by four bays, of which three are devoted to production and one to annealing.

The moulding is carried out by every known process, from the antiquated "Tub" to the most modern type of machine. The number of machines

in operation is about 50, all of the modern type.

Castings of a character likely to "fly" are lifted from the sand and charged direct into a muffle furnace, in which they are subject to a temperature of 800 deg. for a period of 30 hours and then cooled down to normal.

The annealing plant comprises 12 furnaces; of these four, each 14 ft. × 15 ft. × 10 ft. high, are probably the largest in the kingdom on such duty. They are gas-fired, the whole of the control valves being placed at the rear. The operation and temperature of the furnaces are under the separator of a capacity of 30/40 tons of sand and twelve double-head grinders each taking a wheel 18-in. × 3-in.

The compressors comprise three Broom & Wade, each of 600 cub. ft. per min. capacity at 100 lbs. per sq. in., which are belt-driven from motors. Together with three Allday's fans which supply blast to the furnaces, these are housed in a separate building, in which also is the works sub-station, current being received at 7,000 volts and stepped down to 400 and 200 volts for power and lighting respectively.

Auxiliary shops comprise a machine shop—a

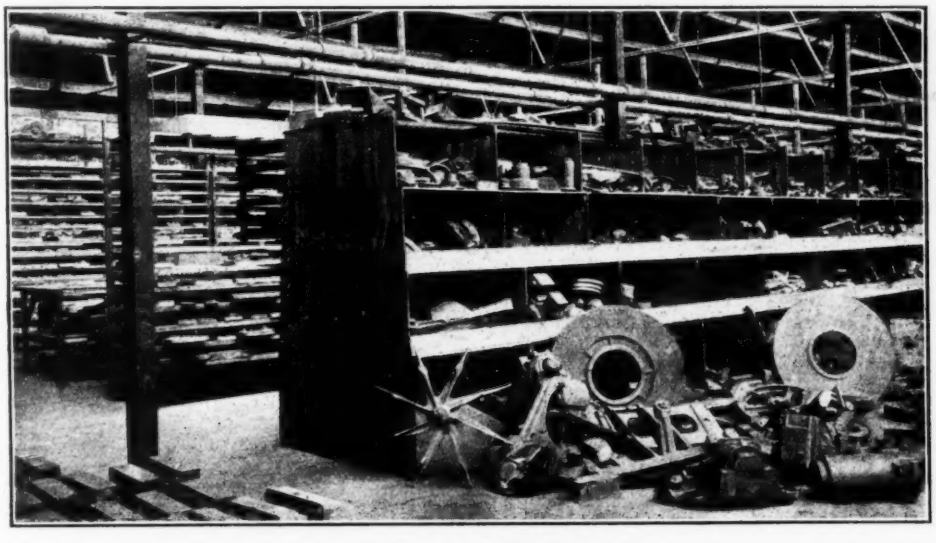


FIG. 5.—CORNER OF PATTERN STORES.

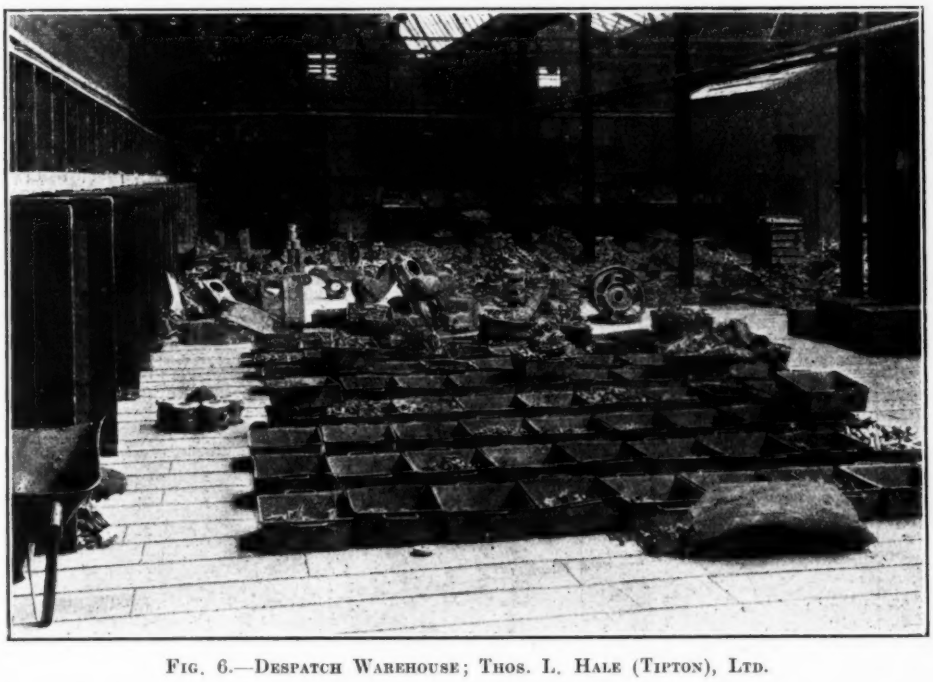


FIG. 6.—DESPATCH WAREHOUSE; THOS. L. HALE (TIPTON), LTD.

direct supervision of the works chemist. Two crucible furnaces are also provided for laboratory experimental work. The core shop is placed in the mid position and is 70 ft. long × 40 ft. wide.

At one end of the foundry is a battery of 9 presses served by a gas-fired furnace. Formerly these presses were in full commission trueing up castings; the whole of them, together with the furnace, are now lying idle, improved methods of production having almost eliminated the necessity for trueing up.

The dressing plant comprises four Tilghman's Sand Blast rooms, which are complete with a sand

recent addition—in which are installed lathes, milling, drilling and shaping machines, etc., to meet customers' requirements for castings finished right out. There is a well-equipped tool room, also a pattern shop, where the work is mostly in the nature of alterations and repairs, as the Company have a controlling interest in an independent pattern-making business. There is a metal-pattern-making shop served with gas-fired crucible furnaces; an inspection shop and works record office; a despatch shop; an extensive pattern stores, which is covered by three bays each 60 ft. × 40 ft., all patterns being stored in

racks. Then there is a well-equipped laboratory, all raw material being subject to rigid analysis, while a considerable amount of research and experimental work is also undertaken.

Gas for all power and heating purposes is taken from the mains of the South Staffordshire Mond Gas Company, of which Company Mr. W. Edgar Hale is also managing director. Every description of casting is made in weights ranging up to 3/5 cwts.; as a matter of fact, a casting weighing 27 cwts. has been made.

The term "Real Staffordshire Iron" has always implied in the engineering world the "best iron produced," and Messrs. Hale appear to be upholding this cherished tradition of their district in their production. Due, apparently, to their record with the British Admiralty, they are supplying all the malleable-iron castings required for H.M.Ss. "Nelson," "Rodney," "Cumberland," "Kent," and "Suffolk." The Company appear at different times to have had entrusted to them some extensive export contracts, the principal one being for the Newfoundland Development Company, which was executed in 1925, one consignment on account of which was over 200 tons, and is believed to be the largest shipment of malleable castings ever made from the United Kingdom. During the same year an extensive contract for the equipment of tin mines on the Malay Peninsula was executed, and at a more recent date a substantial contract was shipped to Siam for railway equipment at Bangkok.

The Properties of Cast Iron as Revealed by the Shear Test.

Generally the mechanical properties of cast iron are judged by the tensile or transverse test. These methods demand test bars of rather large dimensions which cannot be cut from out the castings to be tested. Therefore the test bars must be cast separate, and accordingly have a different cooling rate. Thus they do not represent the properties of any section of the casting. To satisfy this

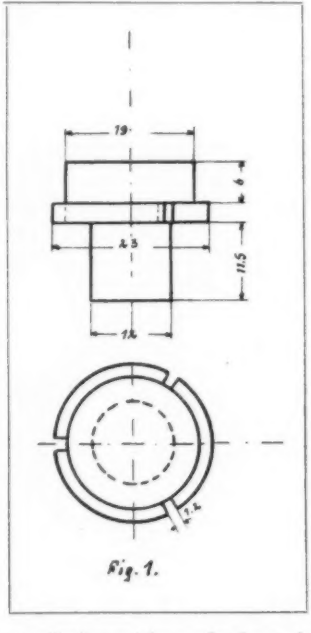
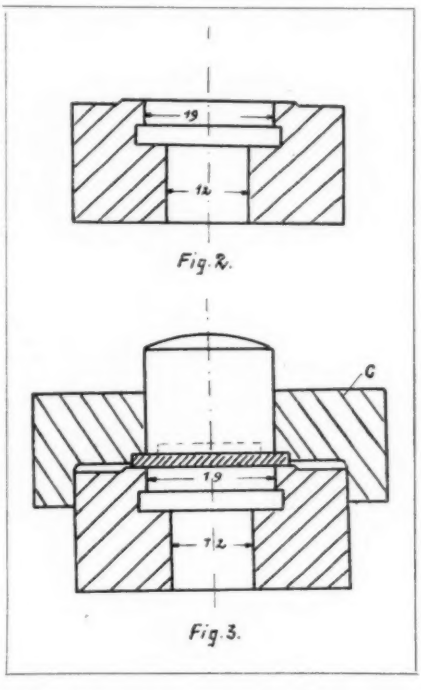


Fig. 1.

demand a method must be evolved requiring small test pieces which can easily be poured to any section and cut therefrom when the casting has cooled down. The shear test elaborated by Sipp approaches to this ideal method in some degree. The shape and size of the test pieces are seen in Fig. 1; they are placed into a matrice according to Fig. 2, and the flange is sheared off by pressure acting on the top of the test piece. M. Rudeloff applied this method to several kinds of cast iron and found the following numerical relationships, taking the torsional strength = 100, assuming it to be the best measure for the shear strength:—

	Per cent.
Torsional strength	100
Shear strength by Sipp	98.1
,, (double shear test)	94.6
Tensile strength (diam. of test bar = 15 mm.) ..	81.2
Compressive strength ,, ,, ..	278.0

In order to diminish the dimensions of the test pieces further, M. Rudeloff* carried out experiments with plates 1.5 to 2.5 mm. in thickness which were sheared off in the same matrice (Fig. 2) by means of a cap, as shown in Fig. 3. In these experiments the strength figures given by this



punching test were compared with the shear strength by Sipp and the double shear test, compressive strength, tensile strength, transverse strength, torsional strength, hardness. The results can be summarised as follows:—

1. The formulæ given by Schütz and Portevin for calculating the tensile strength by means of the Brinell hardness number give values which disagree with the tensile figures of the experiments in question. Rudeloff is of opinion that it is impossible to deduce a generally applicable formula for this purpose.

2. The mechanical properties can be calculated with sufficient accuracy by means of the shear test figures (Te) by Sipp, according to the following formulæ:—

Transverse strength	= 1.42 te.
Tensile strength (bar diameter = 20 mm.)	= .67 te.
,, ,, = 15 mm.)	= .64 te.
Compressive strength	= 2.80 te.
Brinell hardness (ball = 10 mm. diam., load = 3,000 kg.)	= 6.15 te.
Brinell hardness (ball = 10 mm. diam., load = 1,000 kg.)	= 5.80 te.

3. The mechanical properties can also be calculated by means of the punching-test figures (Tst) within the range of 18.0 to 32.0 kg. per mm.², according to the following formulæ:—

Transverse strength	= (Tst—4) 1.85
Tensile strength	= (Tst—8) 1.10
Compressive strength	= (Tst—4) 3.60

4. The relationships between the various mechanical properties given by M. Thomas do not agree with the experiments in question.

MR. G. T. LUNT has been elected a director of Bradley & Foster, Limited, Darlaston Blast Furnaces, Darlaston, and also of Thomas & Isaac Bradley, Limited, of Capponfield Blast Furnaces, Bilston.

* *Die Giesserei*, 1926, Nos. 33 and 34, page 578.

The Ceramic Society.

Refractory Materials Section.

The Refractory Materials Section of the Ceramic Society held its seventeenth meeting at Leeds on September 9 and 10. The place of meeting was the Chemical Lecture Theatre of the University, and the Chairman of the Section, Mr. Frank West, presided over a good muster of members and visitors.

With reference to next year's activities it was announced that the Spring Meeting was to be associated with visits to Prague, Vienna, and several other places in South Central Europe, and that the Autumn Meeting would be held either at Bournemouth or at Glasgow.

The first Paper on the programme, by MR. W. J. REES, B.Sc., F.I.C., was "A Further Note on the Influence of Iron Oxide in Promoting the Inversion of Silica," an abstract of which appears elsewhere in this issue.

MR. J. W. FAGAN next read a Paper by the Chairman and himself entitled "Practical Results and Experience in the Drying and Burning of Refractory Materials," in which a short description was given of the manufacture of silica bricks as carried out at the Friden Works. The Paper includes figures illustrating a drying floor, tunnel dryer and its connections for obtaining and distributing heat, kilns for burning the refractories, and various subsidiary contrivances in use. The tunnel dryer at the outset had a coke-fired furnace at the outlet end, the products of combustion being drawn by a fan to the inlet end, past the trucks conveying the wet goods in the opposite direction. The tunnel holds 26 trucks, each with 64 trays to support the ware to be dried. Under this system 3,500 equivalent 9-in. × 4½-in. × 3-in. bricks were dried per 24 hours. Two or three years ago this direct-firing system was superseded by the Uzallete system for using waste heat from the kilns. Air is drawn through kilns whose cooling can be safely accelerated, and is forced by a fan through the tunnel dryer. The temperature at the inlet of the dryer ranges from 200 to 300 deg. Fah. (93 to 149 deg. C.). The first cost of tunnel dryer and trucks was about £2,070, and the cost of adding the Uzallete equipment with air mains, fan and motor was £310. The saving effected by this change in the drying system was at least £300 per annum on fuel alone, and the kiln output had been speeded up, especially in summer, and the drying was cleaner and more easily regulated.

The main advantage of the tunnel was that it took up very much less ground space per 1,000 bricks dried than the drying floors. At Friden the area occupied per 1,000 bricks dried on the floors in 24 hours was 170 square feet, but for the tunnel dryer only 103 square feet. The tunnel dryer, moreover, carried the drying slightly further than the floors.

The two types of kilns now used at the works had been proved to be most suitable for the purpose. They were the semi-continuous down-draft kilns built in benches and the down-draft beehive kiln. In some of the kilns induced draft was employed and was found to have a great advantage over the natural draft. The kilns were more easily handled and more economical of fuel, the temperatures at the inlet to the chimney being 150 to 200 deg. Fah., as against 350 to 400 deg. Fah. with natural draft. The waste gases leaving the kiln under fire include 11 to 14 per cent. CO_2. One or two beehive kilns were found to be extremely useful in the execution of small orders for urgent delivery.

During the last nine years at Friden the results on burning alone showed about 11 per cent. increased efficiency on the average, apart from improvement in the quality of goods improved. The authors gave some particulars concerning the coal used, which they described as "screened cobbles," the lumps varying from ½ cwt. to large nuts. The following table gives the results of burning.

After the Paper had been prepared, some tests of oil-firing were made, using the series of 6 semi-continuous kilns. The oil cost 85s. per ton. The figures obtained were: Weight of oil used per 1,000 9-in. × 4½-in. × 3-in. bricks, 4 cwts. 3 qrs. 7 lbs.; cost of fuel and labour per 1,000 bricks, £1 0s. 3d., with 3s. 2d. extra for soaking; grog and wasters, 6½ per cent.; theoretical heat efficiency, 52.8 per cent. The figures show the great advantage (as regards efficiency) of the continuous kilns over the beehives.

All the details given represent the results obtained in the ordinary routine of the works. Most of the results are the averages of 6 or more different burnings.

Description of kilns.	Capital cost per 1,000 equivalent squares capacity.	Total capacity in 9″×4½″×3″ bricks.	Weight of coal used per 1,000 9″×4½″×3″ bricks.*	Cost of fuel and labour per 1,000 9″×4½″×3″ bricks.	Gross and wasters.	Theoretical heat efficiency.
	£ s. d.		C. qr. lb.	£ s. d.	Per cent.	Per cent.
Series of 17 semi-continuous kilns ..	29 15 0	240,000	10 0 11	0 17 2	8¼	35.3
Series of 8 semi-continuous kilns ..	32 16 0	203,000	11 0 0	0 18 4	7½	32.4
Series of 6 semi-continuous kilns	34 15 0	45,000	9 3 1	0 1 4 0 16 9	7½	39.5
Beehives	24 2 0	24,000	16 0 22	1 6 4	10	22.3

* For the sake of comparison these figures were taken on the burning of the kilns to an average temperature of 1,500 deg. C., the amount of coal used for soaking being taken separately.

N.B.—In the beehives squares only were burned, but shapes and squares in all the other kilns. The above costs are all based upon pre-strike prices.

The concluding Paper on the first day of the meeting was by DR. G. MARTIN, entitled "Refractory Linings for Cement Kilns," in which a brief account of the usual method of manufacturing cement in this country is followed by a discussion of the distinctive features of the zones in the rotary cement kiln. For the drying and preheating zones, very ordinary firebricks may suffice to serve as lining. In the calcining and clinkering zones, the corrosive action of heated lime, and the considerable abrasive action, call for better materials. A suitable composition for bricks to line the calcining zone is 31 to 33 per cent. alumina, 61 to 62 per cent. silica, 3 to 4 per cent. ferric oxide, 0.8 per cent. titanium oxide, and 0.5 per cent. lime. In the clinkering zone the corrosive action is so powerful that the 9-in. bricks forming the lining are often burned out within a period of three weeks to nine months. As neglect by the burner can destroy a lining in a few minutes, it is difficult to explain the rapid destruction of a lining unless one is on the spot all the time. Bricks known to have given good results for lining the clinkering zone had the following compositions:—Alumina, 33 to 43 per cent.; silica, 58 to 49 to 50 per cent.; ferric oxide, 4.5 to 3 to 4 per cent.; titanium oxide, 1.0 to 2.0 per cent.; lime, 0.7 per cent.

In practice, the difficulty resulting from the rapid corrosion of the lining bricks is overcome by "coating" the bricks, an adherent layer of cement clinker being applied. The burning then takes place upon the cement surface. Bricks of apparently inferior quality can in this way be used for lining the kiln. Works managers have often declared that the way the burner works his

temperatures and rates of feed is more important than the lining bricks. Good results have been obtained with the use of firebricks covered with a cover mixture made of two parts of small cement clinker and one part of cement.

The second day's proceedings started with a Paper by J. F. L. WOOD, M.Sc., DR. H. S. HOULDSWORTH, and PROF. J. W. COBB, C.B.E., on "The Influence of Foreign Matter on the Thermal Expansion and Transformation of Silica."

The work described in this Paper is preparatory to further investigations in a narrower field, the immediate aim being to discover what materials would produce marked effects on the reversible thermal expansion of silica bricks. As raw quartzite was used a Welsh material (Bwlchgwyn quartzite), which is extensively used for making silica bricks. For the tests only quartzite flour was used, which passed through a 100-mesh S.M.M. sieve; 44 per cent. of the material passed through a 200-mesh sieve. The quartzite was composed of 97.6 per cent. silica, with 1.4 per cent. ferric oxide, and small amounts of other substances. For mixing with the quartz, twenty-eight different substances were used separately, 2 per cent. being added in most cases, and test pieces were fired at cones 9, 12, and 14. Measurements were made of the reversible thermal expansion, and specific gravity porosity and refractoriness were determined. The specimens containing 2 per cent. of lime were taken as standard, with which the others burned at the same temperatures could be compared. It was found that boric acid, potassium carbonate, potassium chloride, potassium chromate, biotite, sodium felspar, lithium chloride, ferric oxide, and borocalcite facilitated the conversion of the quartz. The specific gravity did not in all cases give an accurate indication as to the reversible thermal expansion, which may, perhaps, be because some of the quartz had been dissolved, and, after cooling, had retained the expansion characteristics of a glass. Refractoriness of the mixtures was not substantially less than that of the quartz with 2 per cent. of lime, except when 10 per cent. of borocalcite was added (4 per cent. of borocalcite did not seriously impair the refractoriness). It is intended to continue investigations with the more promising materials, used separately, and also mixed together, with greater approach towards commercial conditions as regards grading, etc.

The next Paper was by MR. W. T. GARDNER, on "Refractories in the Gas Industry." In it was collected a lot of useful information concerning the various types of refractories used in the gas industry, with a critical discussion of some of the outstanding points. The topics dealt with include (among others) the characteristic features of fireclay refractories, siliceous refractories, and silica refractories, with special reference to their employment in retort settings.

Suggestions are being made for bringing up to date the standard tests for heating under load and for after expansion, and also for the introduction of an upper limit to the specific gravity of silica refractories.

The last Paper read was by MR. H. M. RIDGE, under the title "Note on Modern Clayworking Machinery as Used on the Continent." With the help of lantern slides, Mr. Ridge explained the advantages attending the use of certain contrivances which he had seen at work, including clay feeders, grinding pans, kiln coal feeders, and clay excavators. He also described a small electrically-heated pottery kiln which he had seen working successfully in Sweden.

Company Reports.

Coltness Iron Company, Limited.—Half-yearly dividends on first and second preference shares.

British Aluminium Company, Limited.—Interim dividend, 4 per cent. (actual), less tax, on ordinary shares.

Sir William Arrol & Company, Limited.—Dividend due on six-and-a-half per cent. cumulative preference shares postponed.

Thos. W. Ward, Limited.—Final dividend on ordinary shares, 5 per cent., free of tax, making 7½ per cent., free of tax, for year.

Stewarts and Lloyds, Limited.—Interim dividends for half-year ended June 30, 6 per cent. per annum on preference shares and 10 per cent. per annum on preferred ordinary shares.

The International Pig-iron Situation.

This subject was discussed at a conference of the German Foundry Owners' Association by Director Dirksen, of the Pig-Iron Union, who *inter alia* stated that the situation of the pig-iron market was characterised in the past year by a scarcity of money, a falling demand, inadequate prices, and sluggish payments. While out of the 212 extant blast furnaces existing in Germany only about one-half were in service at the end of 1925, the number has since further declined to about 80. Deliveries have also experienced a further reduction, the decline to inland consumers being over 50 per cent., as compared with the early months in 1925. The consumption by the foundries and machinery works has fallen off considerably; a number of customers have gone bankrupt, etc., whose total consumption had amounted to 40,000 tons per annum. In connection with the financial failures of such customers the suppliers of raw materials came badly off as the banks only granted credit to customers in return for security given on the raw material and semi-finished goods. The decline in the sale of steel-making pig-iron was particularly great, this being due, besides the reduced activity, to the increased use of scrap-iron.

As to the price policy pursued, it is a well-known fact that the Pig-Iron Union had to take into consideration last year also the competitive prices of foreign rivals. In consequence, however, of existing circumstances it was impossible to prevent occasional underquoting for foreign iron; but this should not afford an excuse for consumers to withdraw their orders from the home industry, especially as consumers themselves have the greatest interest in the stabilisation of prices, and must have gathered during years of experience the impression that the Union pursued a moderate price policy.

During the past year the imports of foreign iron did not show any decrease; they totalled over 200,000 tons in 1925, which quantity represents a considerable portion of the total inland consumption of the material furnished by the Union. In the first half of 1926 the imported tonnage was not very much less in proportion to the total inland consumption of pig-iron. These imports were wholly unnecessary, as the home industry, needing work, would have been able to supply the same qualities of pig-iron at the same prices. The figures give food for reflection, more especially so as British competition was practically non-existent during the months of May, June, and July owing to the coal stoppage.

While the sales of German pig-iron are declining month by month, at a rate which must produce anxiety, matters were quite different with their Western neighbours. In France, Belgium and Luxemburg there is an artificial prosperity of business due to inflation. The blast furnaces are producing at full capacity, and month by month more furnaces are being blown in. In France there were 133 furnaces active in January, 1925; now there are 153 in operation; in Belgium 52 out of the total 55 existing furnaces are in service, or practically all in the country. Consumers in France, Belgium, and Luxemburg are clamouring for more than their actual requirements, and are complaining that the makers are selling large quantities of pig-iron abroad so as to get foreign money. As a consequence restrictions are being imposed in France so as to be able to give preference to the needs of inland customers. The production in these countries is growing month by month, and with the low wages and cheap raw materials the pig-iron industry is able to carry on almost without any competition. The coke delivered on reparation account is supplied to the French blast furnaces at a price which is considerably lower than the price at which the coke is credited to Germany on reparation account, so that the competition of the French blast-furnace industry is greatly facilitated.

In the case of Italy the home industry is being assisted in every way by the economic policy of the present Government. In 1913, Germany supplied to Italy 65,000 tons of pig-iron; deliveries to that destination to-day are practically nil. Thanks to high import duties and the depreciation of the zloty, Poland now appears as a rival in the world's markets, and is rendering German sales in the East extremely difficult, while only very small quantities of foreign iron find their way into Czecho-Slovakia.

The Basset Process.—The French concern, Aciéries Basset, reported last year that works were to be erected at Mortain in Normandy for carrying on the Basset direct process for producing steel. This idea has now been abandoned owing to the very large expenditure the carrying out of the scheme would have involved. It is now intended to erect the works at Dennemont, where the process was originally tried.

Some Mechanical Properties of Silicon-Aluminium Alloys.*

By J. D. Grogan, B.A. (of the National Physical Laboratory, Teddington).

This Paper describes an investigation on the mechanical properties of the silicon-aluminium alloys carried out for the Engineering Research Board on behalf of the Light Alloys Sub-Committee of the Aeronautical Research Committee. These bodies have granted permission for publication.

The increasing interest in silicon-aluminium alloys as materials for light castings rendered it desirable that a careful determination of their properties, when prepared under carefully controlled conditions, should be made in order to arrive at an independent standard of what may be expected of such materials.

The work described in this Paper deals first with two well-known methods of producing the modified structure—the sodium and the "salts" methods. The sodium method is very efficient in effecting modification, but castings produced by its use are not regularly sound. The "salts" method gives more regular results.

Results of mechanical tests are given. Brinell hardness, proof stress, and ultimate stress increase with increasing silicon within the range studied, 8-14 per cent. of silicon, while elongation, Charpy impact value, and density decrease. The presence of massive silicon is always accompanied by a marked decrease in elongation. There is little improvement in mechanical properties accompanying an increase in silicon content above 12 per cent.

The results of some exploratory melts of ternary alloys containing zinc and magnesium are described. Zinc raises the tensile strength of the alloys, but seriously lowers the ductility. It also raises the density very rapidly. Magnesium ruins the ductility without any increase in tensile strength.

EXPERIMENTAL.

Materials Used.

Aluminium. — High-grade notch-bar virgin aluminium containing on the average 0.23 per cent. of iron and 0.17 per cent. of silicon.

Silicon.—Samples of silicon vary very considerably. The main impurities are iron, aluminium, and a constituent insoluble in the usual chemical reagents. This constituent is mainly alumina, but occasionally contains some carborundum. Some samples of silicon are coated in places with a dirty slag. This contains considerable quantities of iron, aluminium, and calcium.

The following are some typical analyses:—

	C.	D.	G.	G. (Slag).
Iron	1.06	3.43	1.42	6.19
Aluminium ..	1.83	1.57	1.80	4.67
Copper	0.02	0.03	—	—
Magnesium ..	0.06	0.15	0.09	0.11
Calcium	0.26	0.48	0.10	1.40
Insoluble	0.08	—	0.20	3.00
Silicon (diff.) ..	96.69	94.34	96.39	84.63
	100.00	100.00	100.00	100.00

The purest available samples of commercial material were selected. It was considered particularly important to keep the calcium content as low as possible, in order to avoid the preparation of alloys which would develop a modified structure without the addition of a modifying agent

Moulds.

The metal moulds used for chill-castings are of cast iron, 1 in. in diameter and 7 in. long, and closed at the bottom with sand. The ratio of weight of mould to casting is about 3:1. The moulds were preheated and dressed with a wash consisting of whiting and water with a little sodium silicate.

Sand moulds were made of greensand, skin dried. Bars were moulded six in a box, radiating like spread fingers from a common runner placed near one corner of the box. Runner and gates were of generous cross-section. No risers were used. It was found to be unnecessary to provide a large head of metal, 1 or 2 in. being ample.

Preparation of Alloys.

The aluminium was melted in a Salamander pot in a gas-fired furnace and heated to about 800 deg. C. The calculated quantity of silicon was added a little at a time. The silicon floated on the surface of the molten aluminium, and was gently pushed under the surface from time to time by means of a graphite rod. When alloying was complete the metal was skimmed and cast into ingots, unless required for immediate use. Generally, on analysis, the silicon content was shown to be about 0.2 per cent. lower than that calculated. This deviation was probably due to the trapping of a certain amount of undissolved silicon in the dross.

Casting.

The metal in the modified condition, whether modified by sodium or by "salts," develops a tough inelastic skin. This was found to make control of the pouring rate difficult, as the skin flows into the mould with the metal and produces long cold shuts and inclusions, mainly on the lower side of the bar. These cold shuts were particularly marked when the mould temperature was low (below 170 deg. C.), but occurred even when higher mould temperatures were employed. With mould temperatures above about 280 deg. C. another trouble occasionally appeared. The lower pouring side of the bar was quite spongy on the surface, as if some reaction had occurred between the metal and the dressing, causing liberation of gas. This phenomenon, though particularly marked with higher mould temperatures, occasionally appeared when the temperature was as low as 200 deg. C. A mould temperature of 200 deg.-250 deg. C. was generally employed.

It was found desirable to pour rather fast both chill- and sand-castings. The time taken to fill a mould 1 in. in diameter and 7 in. long was approximately 4-5 seconds. Little following up was necessary, as the solidification shrinkage in these alloys is small.

The Modification Process.

Effect of Calcium.—The phenomenon of modification has been so frequently described of late that no detailed description will be given here. The effect of the process is to shift the eutectic composition from about 10.5 per cent. to somewhat over 14 per cent. of silicon and to replace the coarse eutectic structure of the normal material by a fine structure. These structures are illustrated in Figs. 1 and 2. This refinement of structure is sometimes referred to as grain refinement, an expression which is rather misleading, since the change is not one of reduction in crystal size, but merely a refinement of structure inside the crystal. Indeed, in modified material the crystals are often of considerable size, probably greater than those of normal material.

In cases where modification has been produced by the usual agents, such as sodium or "salts," the effect is lost to a greater or less extent if the modified metal is remelted or even if allowed to stand in the molten condition. It was observed that, when certain samples of silicon were used in the preparation of the alloys, the metal possessed the modified structure even when no modifying agent was added. This suggested the presence of some agent more permanent in its influence than sodium. All these abnormal silicon samples contained calcium, a material not reported in the first sample of silicon used, which did not produce this effect. Experiments showed that small quantities (0.05 per cent.) of calcium produced modifica-

* A Paper read before the Liege meeting of the Institute of Metals.

tion in chill-cast material, although not so thoroughly as sodium. The eutectic is coarser and primary silicon appears at lower silicon concentrations than in the case of material modified in a more usual manner. The effect of calcium on the structure of sand-cast bars is slight. This modifying power of calcium persists after remelting, and in the present experiments rendered the

FIG. 1.—Si 12 PER CENT. NORMAL STRUCTURE CHILL CAST × 150.

preparation of normal (unmodified) castings impossible, as no further sample of silicon free from calcium could be obtained. A few tests were made on this "self" modified material. The results of these are given in Table I:—

TABLE I.—*Silicon-Aluminium Alloys. Self-Modified Chill-Cast.*

Analysis.		Density.	Ultimate Stress. Tons/in.².	Elongation. Per cent. on 2 in.
Silicon.	Iron.			
11.0	0.4	2.668	12.3	10.0
13.7	0.3	2.656	11.6	4.0
16.0	0.4	2.649	10.3	2.5

NOTE.—In the second and third samples primary silicon appeared, lowering the elongation.

Some experiments were made to determine the amount of silicon which could be present in modified material without the appearance of primary (massive) silicon. Alloys containing 14 per cent. of silicon or less were readily modified and contained no massive silicon. Alloys containing more silicon than this were irregular in behaviour, being sometimes well modified, at other times containing massive silicon and often aluminium dendrites as well. It was found that the conditions of pouring profoundly influenced the microstructure of the higher silicon alloys. Occasionally such chill-castings contained massive silicon, while sand-castings made from the same melt contained none.

Figs. 3 and 4 are photomicrographs of 1 in. diameter chill-castings of an alloy containing 14.3 per cent. of silicon. The structure shown in Fig. 3 is of a bar poured very fast; that in Fig. 4 was poured slowly. Six bars were poured in all, alternately fast and slow. All the bars poured fast were nearly free from massive silicon and were composed of fine eutectic. All the bars poured slowly contained much massive silicon embedded in aluminium dendrites. Sand-cast bars from the same melt possessed a structure very similar to that of Fig. 3. It appears likely that the agitation during solidification caused by slow pouring was responsible for the appearance of massive silicon and aluminium dendrites in these castings.

Analysis

The method employed for the determination of silicon in these alloys was very similar to that independently developed by John D. Gat.* The material was sampled by turnings from a complete cross-section, or by drillings or millings taken from a small dip sample cast in a metal mould. Two grms. of the sample were dissolved in 30 per cent. soda solution in a covered nickel crucible, or a beaker of resistance glass. Both the aluminium and the silicon dissolved with evolution of hydrogen. When the sample was completely dissolved the solution was diluted with water, made acid with sulphuric acid, and evaporated to fuming. Silicon was then estimated in the usual way. This method was found to be superior to that of dissolving the sample in acid and weighing the silicon as such, as the particles of silicon were so small that filtration was difficult, and some of the silicon passed through the filter paper. Also the finely divided silicon slowly oxidised on ignition, so that it was impossible to ignite to constant weight.

The Sodium Method of Modification.

In this method an alkali metal is added to the molten alloy just before casting. The alloy was melted in a Salamander crucible in a gas-fired furnace and heated to about 760 deg. C. The crucible was then removed from the furnace, the metal skimmed, and the desired quantity of sodium thrown on the surface of the molten metal. By means of a preheated inverted crucible mounted on a long handle, the sodium was forced beneath the surface of the metal and stirred in. A quantity of the sodium always floated to the surface and burned there. When stirring was finished the metal was skimmed and poured at 720 deg. C. for chill-castings and 650 deg. to 680 deg. C. for sand-castings. The sodium was weighed out under paraffin, and kept so until required for use. The quantity used was 0.05 per cent., or 0.1 per cent.; 0.05 per cent. was sufficient to produce the fully modified structure in alloys containing less than 12 per cent. of silicon. With alloys containing more silicon than this it was found better to add 0.1 per cent. sodium, though even with this amount primary silicon was always present in alloys containing 14 per cent. silicon or more.

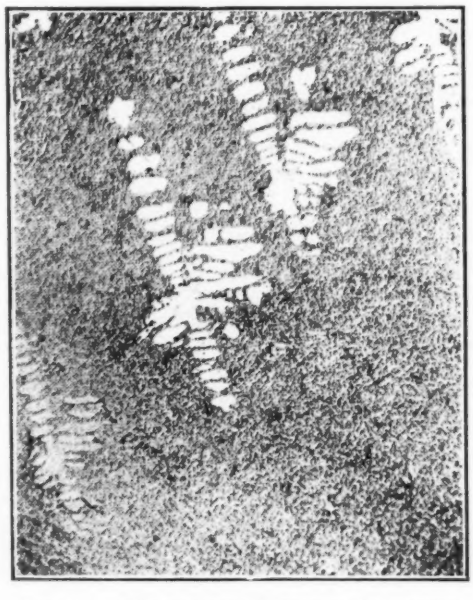


FIG. 2.—Si 13 PER CENT. MODIFIED STRUCTURE SAND CAST × 150.

Microscopical examination showed that the modified structure was produced in a thorough manner by this method. Material modified by the process, however, proved unsatisfactory. Density was irregular and often low. Longitudinal sections of bars of low density sometimes showed no marked

* Indust. and Eng. Chem., 1924, 16, 959—960.

unsoundness, but often showed pinholing and occasionally a central cavity. Variation of composition, of metal and mould temperatures and of rates of pouring, led to no regularity in results. Occasionally a batch of castings would give satisfactory density figures and mechanical properties, but the conditions for the regular production of such castings were not discovered.

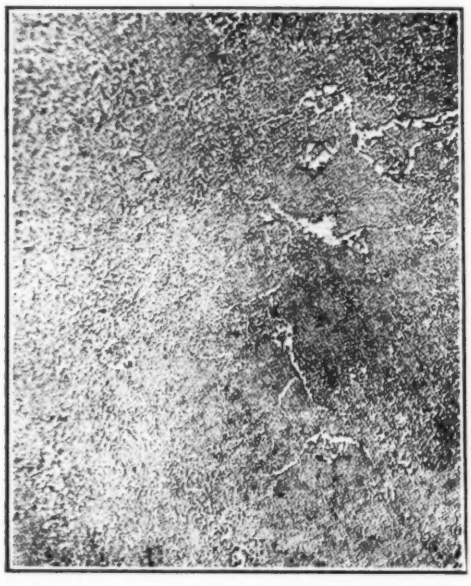


FIG. 3.—SI 14.3 PER CENT. CHILL CAST POURED FAST.

A Paper has recently been published on this subject by Archer and Kempf.* They find that the amount of sodium required depends on the silicon content of the metal, and that a definite period of delay between the treatment with sodium and pouring the metal produces satisfactory results.

"Salts" Method of Modification.

In this method the molten metal is treated with a flux containing fluorides of the alkali metals.

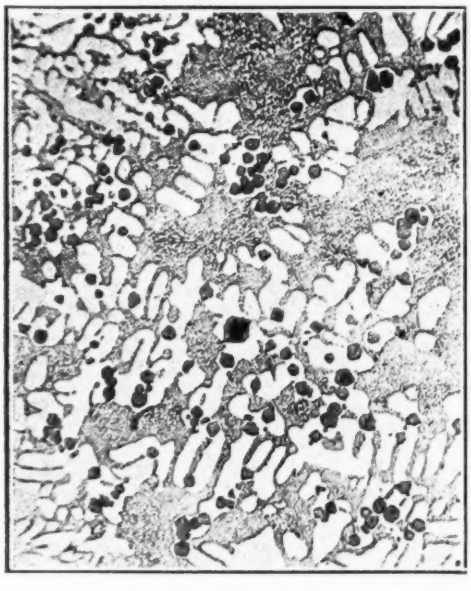


FIG. 4.—SI 14.3 PER CENT. CHILL CAST POURED SLOWLY.

The method described below is substantially that employed by Messrs. Lightalloys, Ltd., the proprietors of "Alpax," who were kind enough to demonstrate their method and also to sanction its publication. The "salts" mixture is composed of:—Sodium fluoride, 2 parts, and sodium chloride, 1 part.

The metal is melted in a crucible and the temperature raised to 900 deg. C. The crucible is

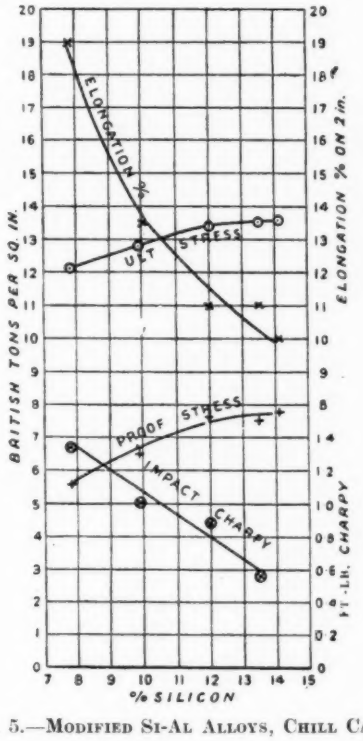


FIG. 5.—MODIFIED SI-AL ALLOYS, CHILL CAST.

removed from the furnace and sufficient "salts" is thrown on the surface to form a layer about 0.25 to 0.5 in. thick. The crucible is then covered with a lid and left for 7 minutes. By this time the metal has cooled to the pouring temperature, 720 deg. to 750 deg. C. The crust of salts is removed from the surface and the metal poured. If the initial temperature of the metal is too high,

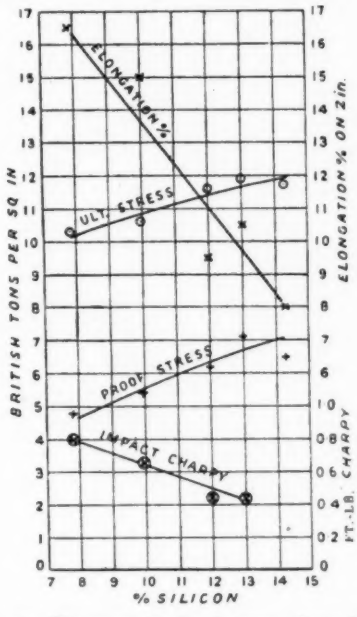


FIG. 6.—MODIFIED SI-AL ALLOYS, SAND CAST.

the "salts" melt and flames are produced when the mixture is thrown on the metal. The temperature is correct when the mixture just begins to melt and a little flame appears.

The mixture is somewhat hygroscopic and damages the crucibles in which it is used, unless

* Amer. Inst. Min. Met. Eng. (Advance Copy), 1926, Feb.

they are carefully cleaned. The crucibles are best cleaned by heating to red heat and scraping while still hot. If scraped cold considerable force is needed to remove the incrustation of salts.

The sodium and "salts" methods were compared as follows:—28 lbs. of an alloy containing 13 per cent. of silicon was made up and cast into ingots. The metal was divided into four equal portions. No. 1 was remelted and six 1 in. diameter chill-cast bars were cast from it. No. 2 was modified with 0.1 per cent. of sodium and bars cast in the usual way. No. 3 was modified with 0.1 per cent. of sodium, which was enclosed in a

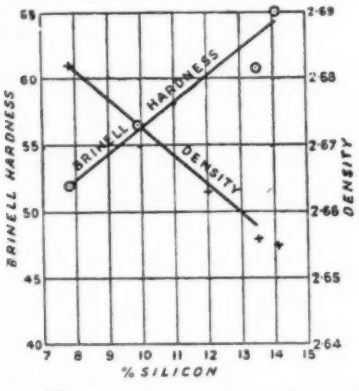


FIG. 7.—MODIFIED SI-AL ALLOYS, CHILL CAST.

capsule made of thin sheet aluminium. Much of the sodium escaped from the melted capsule, floated to the surface and burned there. No. 4 was modified by the "salts" method.

Microscopic examination gave the following results:—No. 1.—Eutectic generally fine and well modified; some coarser crystals of eutectic and a little massive silicon; sound.

No. 2.—Very well modified; no primary silicon or coarse eutectic; not quite so sound.

No. 3.—Eutectic very well modified, but a little massive silicon in small pieces; unsound patches.

No. 4.—Very well modified; no primary silicon; sound on the whole; one or two small holes.

The mean physical tests are set out in Table II.

TABLE II.—*Physical Properties of 12 per cent. Si-Aluminium Silicon Alloy.*

No.	Analysis.			Density of Cropped Bars.	Ultimate Stress. Tons/in.².	Elongation Per cent. on 2in.
	Iron.	Silicon.	Sodium.			
1	0.39	12.7	0.002	2.660	11.3	4.0
2	0.39	—	0.0086	2.646	12.1	5.3
3	0.39	12.9	0.008	2.645	11.9	5.0
4	0.39	12.8	0.004	2.658	13.4	8.3

These figures showed the superiority of the "salts" method over the sodium method as practised in this investigation. The sodium content of the metals was determined by the method of Fairlie and Brook.* The quantity of sodium needed to produce the modified structure was extremely small.

* J. Inst. Metals 1924, 32, 283-289.

Mechanical Properties.

The investigation was continued, the "salts" method of modification being employed. The results reported here refer to material selected on the basis of density determinations, and probably are rather superior to the average figures likely to be realised in practice, unless very special care is taken to secure sound castings. It was found, however, that after some practice the method worked smoothly and produced satisfactory castings with reasonable regularity.

Examination and Testing of Cast Bars.

Surface Appearance.—All bars were examined for surface defects. Bars, both chill- and sand-cast, from metal not deliberately modified, were almost invariably satisfactory, free from cold shuts and inclusions. Chill-cast modified bars were less satisfactory, owing to the presence of cold shuts and spongy patches on the surface. Sand-cast modified bars were, as a rule, satisfactory and free from these defects.

Density.—Density was determined on unmachined bars cropped to a length of 6 in., and was used as a measure of soundness. The value taken was the ratio of weight in air divided by the weight in air, minus the weight in water. This uncorrected value is employed in all tables and figures of the Paper. The correction for temperature and buoyancy is – 0.005. The corrected figure is accurate to about 0.01. The degree of accuracy, relative to each other, of the figures quoted is considerably higher. As the solid solubility of silicon in aluminium is small, and as no compound of the two is formed in the system, the density of any alloy should lie on the line joining the density of aluminium (2.71) to that of silicon (2.40). It was found that the density of satisfactory chill-castings actually fell close to, but below, this line, the discrepancy increasing somewhat with increasing silicon. The density of sand-castings was slightly lower still. The close agreement of observed densities with calculated values indicated that the castings were satisfactory and reasonably free from cavities.

Mechanical Tests.—The mechanical tests made included Brinell hardness, proof stress, ultimate stress, elongation, and Charpy impact test. The results of these tests are plotted in Figs. 5 and 8, and given in Table III.

Charpy test-piece dimensions: Cross-section = 5 × 5mm. Bottom of notch = 5 × 3.5mm.
Form of notch = "V," angle 45°, root radius = 0.25mm.

$$\text{Density} = \frac{\text{weight in air}}{\text{weight in air} - \text{weight in water}}$$

Brinell hardness, ball, 10 mm.; load, 500 kg.
Ultimate stress, British tons per sq. in.
Proof stress " " "
The proof stress is that stress which will produce a permanent deformation of 0.5 per cent. in a length of 2 in.

Density.—Density decreases linearly with increasing silicon from 2.68 for the 8 per cent. alloy to 2.655 for the 14 per cent. alloy in the case of chill-castings. With sand-castings these figures are slightly lower, 2.68 and 2.65 respectively.

TABLE III.—*Silicon-Aluminium Alloys "Salts" Modified.*

Analysis.		Density.	Brinell hardness.	Proof stress. Tons/in.².	Ultimate stress. Tons/in.².	Elongation per cent. on 2 in.	Charpy Ft.-lbs.
Silicon.	Iron.						
			Chill.				
7.8	0.3	2.682	50.4	5.6	12.1	19.0	1.34
9.8	0.3	2.673	55.3	6.5	12.8	13.5	1.01
12.0	0.4	2.663	60.5	7.6	13.4	11.0	0.89
13.5	0.45	2.658	61.5	7.5	13.5	11.0	0.56
14.1	0.45	2.655	65.0	7.8	13.6	10.0	—
			Sand. Moulded Horizontally.				
7.8	0.3	2.680	43.9	4.8	10.3	16.5	0.80
10.0	0.3	2.671	46.9	5.4	10.6	15.0	0.66
12.0	0.4	2.661	50.8	6.2	11.6	9.5	0.45
13.0	0.5	2.651	55.1	7.1	11.9	10.5	0.44
14.3	0.65	2.651	56.8	6.5	11.7	8.0	—

Proof Stress.—The proof stress is taken as that stress which produces a permanent deformation of 0.5 per cent. on a length of 2 in. The proof stress increases steadily from 5 to 6 tons/in.² for the 8 per cent. alloy to 7.8 tons for the 14 per

cent. alloy chill cast. For sand-cast material the corresponding figures are 4.8 and 6.5. Recently a new definition of proof stress has been put forward, the figure 0.15 being substituted for 0.5 per cent. Under this definition the proof stress of chill-cast material containing 13.2 per cent. of silicon is found to be 5.2 tons/in.², under the old definition 7.4 tons/in.².

Ultimate Stress.—The ultimate stress rises from 12.1 tons/in.² for the 8 per cent. alloy chill-cast to 13.4 for the 12 per cent. alloy. With further increase of silicon the rise in ultimate stress is very slight. For sand-cast material the corresponding figures are 10.3 tons/in.² and 11.6 tons/in.². Here also the effect of further silicon is slight.

Elongation.—The elongation falls rapidly from 19 per cent. for the 8 per cent. alloy to 11 per cent. for the 12 per cent. alloy is in the chill-cast state. Further addition of silicon produces little effect. For sand-cast material the corresponding figures are 16.5 and 9.5. Here, again, further addition of silicon produces little effect.

Notched-Bar Impact Tests.—These figures were determined in the Engineering Department of the Laboratory on test-pieces of 5 × 5 mm. cross-section. The Charpy impact figure falls from 1.34 ft.-lbs. for the 8 per cent. chill-cast material to 0.56 ft.-lb. for material containing 13.5 per cent. silicon. In sand-castings the value falls from 0.80 ft.-lb. for 8 per cent. to 0.44 ft.-lb. for 13 per cent. material.

Fatigue Range.—The fatigue range of one chill-cast alloy was determined by the Engineering Department by the Wöhler method. The alloy contained by analysis silicon 8.5 per cent., iron 0.3 per cent. The following results were obtained. The temperature of test was 15 deg. C.:—

TABLE IV.—*Fatigue Test.*

Range of Stress Applied. Tons/in.².	No. of Cycles of Stress. Millions.	Broken or unbroken.	Estimated limiting fatigue range. Tons/in.².
±2.98	13.4	Unbroken	±4.2
±4.05	20.0	,,	
±4.26	10.16	Broken	
±4.69	8.85	,,	
±5.20	1.49	,,	

Brinell Hardness.—Brinell hardness increases with increasing silicon from 50 for 8 per cent. material to 65 for 14 per cent. material chill-cast. For sand-cast material the corresponding figures are 44 and 57.

Ternary Alloys.

Zinc.—Alloys were made up containing 8 and 12 per cent. of silicon, and roughly 5 and 10 per cent. of zinc. They were modified in the usual way by the "salts" methods and cast in 1 in. diameter metal moulds. The eutectic structure was not so fine as that of binary alloys of the same silicon content. A little primary silicon appeared in alloys containing 12 per cent. of that element. The addition of zinc raised the tensile strength somewhat, but considerably lowered the ductility. The results of tests are given in Table V.

The author wishes to express his indebtedness to the Engineering Research Board for permission to publish this investigation; to Messrs. Light-alloys, Limited, for information on the "salts" method of modification and permission to publish details; to Dr. W. Rosenhain, F.R.S., for much valuable advice on the work; and to Mr. N. P. Tucker, of the National Physical Laboratory, for analyses, and for the description of the method of estimating silicon in these alloys.

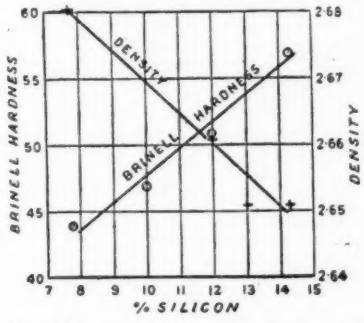


FIG. 8.—MODIFIED SI-AL ALLOYS, SAND CAST.

Catalogues Received.

Gravity Conveyors.—Messrs. Herbert Morris, Limited, of Loughborough, have sent us a beautifully coloured broadsheet, printed by the offset process, which makes a general appeal for the utilisaton of gravity conveyors.

Foundry Plant.—A real contribution to foundry catalogue libraries has just been made by Messrs. New Alldays & Onions, Limited, of Great Western Works, Small Heath, Birmingham, and 9, Victoria Street, London S.W.1. This firm, it will be remembered, recently purchased the goodwill, patterns, and drawings of Thwaites Brothers, Limited, and the first section of the catalogue is devoted to the various types of blowers previously manufactured by this firm. Then follows illustrated descriptions of the blower's great rival, so far as cupola work is concerned, the blowing fan. Smiths' hearths and accessories, for which the firm has been noted for many years, are given quite a large section. This is necessary, as the trades which utilise it are extremely numerous. Another important section is devoted to power forging hammers, of which many types are illustrated and described. The section for furnaces includes hardening, annealing, case-hardening, milling, tyre heating, riveting, using in varying cases coal, coke, gas and oil. Oil firing however, predominates, and a speciality in burners has been created. The well-known "Rapid" and "Dwarf" cupolas (Thwaites) are fully described, together with the mechanical chargers which are to be associated with them. Baby Bessemers, ladles of all capacities and duties, tumbling barrels, pig breakers, crucible tongs, and other foundry specialities, which are set out in detail. This by no means exhausts the foundry tools made by this firm. The catalogue contains 170 well-illustrated art pages, and is stoutly bound in blue linen with gilt letters.

TABLE V.—*Ternary Silicon-Aluminium Alloys with Zinc and Magnesium. Chill-Cast. "Salts" Modified.*

Analysis.				Density.	Brinell Hardness.	Proof Stress Tons/in.².	Ultimate Stress Tons/in.².	Elongation Per cent. on 2 in.
Silicon.	Zinc.	Magnesium.	Iron.					
7.9	4.8	—	0.3	2.768	54.8	7.0	13.9	14
7.4	10.7	—	0.3	2.870	78.4	10.8	16.0	4
12.3	4.7	—	0.4	2.741	62.5	7.9	14.5	5
11.8	8.8	—	0.4	2.816	72.8	9.9	16.5	4
8.2	—	0.36	0.4	2.678	60.1	7.1	10.8	3
8.3	—	0.7	0.5	2.674	63.5	8.3	11.6	2
12.9	—	0.46	0.4	2.658	67.0	8.3	13.0	3
12.8	—	0.63	0.4	2.655	68.7	8.7	11.9	2

Magnesium.—Alloys were made up containing roughly 8 and 13 per cent. of silicon and 0.4 and 0.7 per cent. of magnesium. These were treated in the same way as the zinc alloys. It was found that the addition of magnesium ruined the ductility and did not improve the tensile properties. The results are given in Table V.

XUM

Influence of Iron Oxide in Promoting the Inversion of Silica.*

BY W. J. REES.

In a previous Paper the author, in collaboration with Mr. W. Hugill, compared the properties of lime-bonded silica bricks made from normal ganister and selected lumps of the same ganister coated with marcasite and pyrites. The bricks made from the ganister with the pyritic incrustation contained 1.21 per cent. Fe_2O_3, and showed a higher degree of quartz inversion and greater mechanical strength than the bricks containing 0.71 per cent. Fe_2O_3 made from the normal ganister with identical heat-treatment. It is also shown that, with identical grading and heat-treatment, bricks made from normal crushed ganister had a higher degree of quartz conversion than bricks made from normal crushed ganister which had been washed with warm *aqua regia* to remove iron and iron compounds. The favourable effect of iron oxide on the rate of quartz inversion and on the mechanical strength of silica bricks was also indicated by comparative observations made on clean homogeneous bricks and bricks from the same kiln showing slight mottling due to iron inclusions from pan wear.

The present author, in examining a batch of commercial silica bricks recently, noticed that several of the bricks contained dark spherical patches from one-quarter to three-quarters of an inch in diameter with a small hole at the centre. These patches were evidently caused by iron-inclusion in the brick-patch from crusher or pan wear and its subsequent oxidation and local diffusion during the burning of the bricks. The bricks were very tough and the average powder density of three bricks fairly free from iron-mottled patches was 2.34, indicating good burning and a good degree of quartz conversion. An analysis of the clean bricks tested for powder density gave the following results:—Silica, 94.57 per cent.; titanium oxide, 0.35; alumina, 1.18; iron oxide, 1.54; lime, 1.75; magnesia, 0.19; potassium oxide, 0.48; sodium oxide, 0.32 per cent.

Analyses and micro-sections were made from carefully cut-out medium-brown and dark-brown portions of the dark patches of the bricks, and of a portion of normal brick near to the dark patch. In the following table, *A* is the analysis of the medium-brown portion of brick, *B* of the dark-brown portion, and *C* of the normal-brick portion.

	A	B	C
	Per cent.	Per cent.	Per cent.
Silica	92.92	92.29	94.63
Titanic oxide	0.36	0.38	0.36
Alumina	1.12	1.14	1.15
Iron oxide	2.88	3.49	1.12
Lime	1.74	1.71	1.76
Magnesia	0.17	0.19	0.19
Alkalies (as K_2O) ..	0.72	0.69	0.74
	99.91	99.89	99.95

As would be expected from the powder density the normal brick contains very little unconverted quartz and a fair proportion (15 to 20 per cent.) of tridymite in minute crystals. It is evident from observations that the presence of iron oxide in a silica-brick batch effects at normal silica-brick kiln temperatures not simply a greater degree of quartz inversion, but also an acceleration of the rate of tridymite formation. There is no indication of fluxing or fusion in the ferruginous patches of the brick. Small cones made from the ground ferruginous patches were compared in a gas-fired test furnace with similar size cones made from ground normal brick, and there appeared to be very little difference in the refractoriness of the test-cones. The margin of refractoriness in favour of the normal brick cone was not more than 10-20 deg. An ordinary test on the normal brick gave its refractoriness as cone 32, so that the refractoriness of the ferruginous portion of brick would be slightly higher than cone 31. It would be possible to offset this slight reduction in refractoriness by a small reduction in the lime content of the bricks.

It appears possible that the presence of 2 to 3.5 per cent. of iron oxide in silica bricks for use in open-hearth or other metallurgical furnaces would be advantageous as the increased tridymite content of the bricks would result in greater volume stability and reduced spalling tendency. For coke-oven bricks it is probable that the advantages of greater tridymite formation would be offset by the effect of the iron oxide in promoting cracking of carbon monoxide and internal deposition of carbon in the bricks. A few determinations of the metallic iron content of silica-brick batches have been made using a magnetic separator. The results showed wide variations, the removable iron varying between 0.50 and 0.75 per cent. of the weight of the batch.

* From a Paper read last Thursday before the Autumn meeting of the Ceramic Society (Refractory Materials Section) at Leeds.

Some Instances of the Misapplication of Metal.

BY H. LITTLEHALES.

Iron in the construction of buildings is, of course, often used. It is employed in the form of chains surrounding the drums of great domes to aid in resisting the lateral pressure. It is seen in saddle bars, stay rods, and in various other forms. The employment, however, of iron in forming several of the engaged shafts of the clustered piers of a cathedral must be almost certainly a unique instance of an unhappy architectural use of the metal.

About 100 years ago it was found necessary to make considerable alterations to the eastern piers of the southern side of the nave of Winchester Cathedral. These piers bear many traces to-day of the alterations then carried out, and especially is this the case with several of the engaged shafts on the east and west sides of each pier, these shafts presenting, on a close inspection, features of a curious and very unusual appearance. The colour is not quite the same as that of the other piers, and the joints differ largely, appearing in places to be as much as four or five feet in their spacing. If one taps these shafts the sound on percussion gives a result not quite that to be expected, though, like other engaged shafts in the church, their surface has been scratched and cut into by the penknives of visitors.

Yet it is stated on very good authority, though the fact is not commonly referred to in works on the cathedral, that these shafts are of iron! Each section of one of these strange shafts appears in the form of a cast-iron cylinder of some four feet in length.

No reason, so far as the present writer is aware, has been at any time advanced as an explanation of this strange use of metal in place of stone. At a casual glance, nothing unusual is to be seen in the appearance of these shafts. Their resemblance to stonework is increased by the fact that they are heavily covered with some sort of composition.

At the cathedral of Rouen, the great central spire is a beautifully-designed mass of open cast ironwork bolted together in many sections, and rising to the enormous height of over 500 ft. The use of metal in this instance may very reasonably be considered as misapplied, though the effect of the whole at first sight is from a distance one of much majesty and beauty.

In these days the reduction of cost is frequently demanded, and the employment of iron in the place of copper tacks for the fastening of metal sheeting is often resorted to. But such a substitution, though on the face of it a saving, is of questionable value in the long run, and the use of iron tacks is certainly a misapplication of metal.

Another instance of misapplication of metal now long since discontinued was the use of iron in the manufacture of chamber utensils, the addition of enamel in connection with such vessels being in early days unknown. It is apparent that the use of iron alone for such articles was an absurdity. A very rare seventeenth century example of such a utensil is to be seen in the Tudor House museum at Southampton.

The Purchasing of Steel.

Writing on this subject in the "Journal of the Association of Drop Forgers and Stampers," MR. R. W. RICHARDSON expresses the belief that the great majority of concerns employ a central purchasing department which is controlled by a man of considerable commercial ability but who, as a rule, has little technical knowledge. These men usually refer technical matters to those more qualified to deal with them, but there is always a grave danger of steel being purchased in a routine manner when the purely commercial man is at the helm. On the other hand, there is also a danger of the purely technical man incurring unnecessary expense owing to his refusal to accept anything which deviates in the slightest degree from the official specification laid down by him. This being so, it would seem that the only satisfactory method of achieving efficient buying of steel and similar supplies, is to develop the commercial ability of a class of purchasing agent who already possesses the necessary metallurgical knowledge.

At one time practically the only method employed in ordering steel was to specify certain mechanical tests which had to be obtained from the steel bars, billets or ingots. This method is still in vogue to a considerable extent to-day. It may be argued that as a number of buyers of drop stampings demand their goods to a mechanical specification alone it should naturally follow that the steel bar from which the stampings are made should be ordered in the same way. A little consideration will, however, make it clear that such a policy is not an ideal one, it being open to several serious drawbacks. When such a method is employed it allows the steel maker too much latitude in determining the composition of the steel which he will supply.

It is also quite common practice to simply demand a mechanical test range without specifying the condition of the steel when the tests are taken. It is clear that good mechanical tests can be obtained from inferior steel after being subjected to careful heat treatment. Such steels may or may not be satisfactory from the drop forger's point of view, but if the steel has passed the mechanical test demanded it is a difficult matter to obtain adequate redress from the steel maker in the event of the material being subsequently found wanting in any way. The proof of the foregoing is simply obtained by sending broadcast an inquiry for steel to a number of reputable manufacturers, which steel is only specified to meet a mechanical test. The wide variation of the prices offered for one and the same steel prove that the steel makers are not of one accord as to what is actually required.

It may be thought that provided the method of heat treatment to be employed is also specified then this, in conjunction with the mechanical test, should be all sufficient. That this is not so can be shown in many ways. For example, no provision is made for the mass effect which is always in evidence when steel is heat-treated in any way. With carbon steels, in particular, the effect of the mass plays a large part in determining the mechanical test obtainable. It is clear that a large section of steel will not cool so quickly as will a small section, and as the mechanical properties of steel are largely determined by its rate of cooling from its critical range, it follows that different sections of the same steel cooled in the same way will give different mechanical tests. Moreover, for the same reason, a test-piece from the centre of a steel bar of large section will be different from that cut from the outside of the same bar. The effect of the presence of phosphorus and sulphur in steel is not made manifest by the results of mechanical test, even when these elements are present in considerable quantity.

A perusal of the foregoing points to the fact that the simple demand for mechanical-test results is a bad policy to adopt, and that a more reliable method is to specify a reasonable range of chemical composition. The only case where this latter policy may not be entirely advocated is where the very commonest classes of steel are required for structural purposes, and the like, or where free machining steel is the one and only consideration. The formulating of chemical specifications is not a difficult matter provided that the buyer is able to state what mechanical test will be obtained from steel of any chemical composition after being subjected to a specific heat treatment in different sections.

A large number of branded steels are on the market, and there exists a certain amount of confusion as to the purchasing of them. Very often extravagant claims are made for steels of very ordinary composition, and it is common for equally extravagant prices to be demanded. Broadly speaking it can be said that whilst there is often benefit in purchasing branded steels which possess exceptional properties, and which steels are generally of the alloy variety, there is usually no good purpose served in buying straightforward carbon steels under a steel-maker's brand name. In any case, it is always instructive and helpful to analyse all steels purchased—especially foreign.

In addition to analysis, sulphur prints should always be taken from all consignments of steel to determine the extent of the segregation. It is fortunate that such an extremely simple, cheap, and rapid method as sulphur printing exists for proving the presence or otherwise of such segregation. Its inclusion in a specification does not increase the price of the steel at all, and it should be rigidly insisted upon for all classes of steel. It is, of course, well known that basic steel is more liable to be segregated than is steel made by the acid process. Especially is this the case with low-carbon basic steels. This tendency has had the effect in some quarters of generating a belief that basic steel is inferior to acid steel. To some extent this is true because bad basic steel is practically worthless, but good basic steel is in the majority of cases the equal of good acid steel, and indeed for specific purposes there is little doubt but that it possesses advantages which are lacking in acid steel.

Dust-proof Concrete Floors.

Some time ago in an editorial we mentioned that a foundry in Belgium had provided dust-proof concrete floors for the pattern shop. Mr. Varlet, the manager of the foundry in question—S.A. Esperance-Longdoz, of Liège—has been kind enough to furnish the following particulars. A translation of his communication reads:—

"The floor of our shop has been carried out in concrete supported by means of girders, as shown in Fig. 1. The concrete is allowed 20 days to dry, when the final layer—well mixed before the addition of water—is prepared in the following way:—Two-thirds of Rhine gravel are well mixed with one-third weak sand. Portland cement being

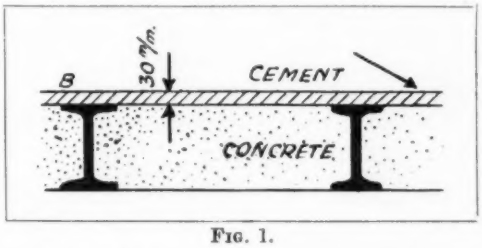


FIG. 1.

gradually added until the quantity reaches the proportion of 1 part of cement to 2 parts of the mix. Before placing on this final layer it is essential to clean carefully the surface of the concrete and very thoroughly to wet it.

"The final layer is added in the form of a nearly liquid mortar, which by means of straight-edges is spread over the floor to a depth of 30 mm. After a few minutes the cement, which soon hardens, should be well smoothed by means of wooden trowels. A drying period of eight days is allowed, when a coat of "tar-varnish" is given and repeated every two days. If possible, two, or better still, three coats should be given in order to assure a satisfactory job. This tar-varnish is a by-product of the coke ovens. It is very fluid and dries very rapidly. We have been using 'Fixol' varnish made by the S.A. d'Ougrée-Marihaye and sold by the Société Commercial de Belgique, à Ougrée."

Book Reviews.

Tungsten: A Treatise on the Metallurgy, Properties and Applications. By Colin J. Smithells, D.Sc. Published by Messrs. Chapman & Hall, 11, Henrietta Street, London, W.C.2. Price 21s. net.

In his preface the author states he finds in the ever-increasing industrial application of tungsten an excuse for the publication of the book under review. We can assure Dr. Smithells that no excuse is needed, as metallurgists all over the world have long been waiting for such a book. When information was required on this subject a difficult search had to be made. The book is divided into ten chapters, the first of which deals with such phases as its discovery, development and distribution. The last is demonstrated to be exceedingly wide by the fact that Table I, which states the annual production of various countries, usually shows that "other countries" has next to the largest individual output. The second chapter—The Preparation of Tungstic Oxide—deals with an essential preliminary operation, prior to a second one, the purification, to which subject a further chapter is devoted. The third stage, the reduction of the tungsten oxide to the metal in general by hydrogen, is dealt with from several interesting aspects. The lesser-used methods, such as by means of carbon or electrolysis, are also included. The manufacture of ductile tungsten is described in Chapter V. In it or later we expected to find some information respecting the manufacture of electrodes such as are used in connection with lamps for the production of ultra-violet rays. We gather that they are made by swaging the treated compressed powder (ingot). Two chapters are devoted to the "metallography of tungsten," but we consider that they bear a very misleading caption, and we believe that an improvement would be effected by renaming them the "metallurgy of tungsten," and, after all, the end both sought and accomplished is to expose the metallurgy, using the microscope as its principal tool.

Because of its use in illumination, the properties set out in Chapter VII are of such a specialised character that comparison cannot be made with the commoner metals on account of their non-existence or rareness. The average metallurgist is quite unfamiliar with the properties of metals in relation to light emissivity. The tensile strength is shown in kilograms per square millimetre, a recent and, to our mind, sensible departure from the normal British expression.

In the chapter on Industrial Applications one little error has crept in. A range taking in the compositions of high-speed steel includes vanadium as an essential. If there was a brand of steel called "Daisy," then it is highly probable that "Daisy-Superior" would only contain vanadium.

In the final chapter some analytical notes on the determination of impurities are given. We were rather disappointed to find no reference to oxygen, as it has the aggravating habit of causing a chemist to report the content of a sample of tungsten powder at 101 or more per cent. of tungsten. This is a section which will be critically examined by the Sheffield steelworks chemists, who possess a good deal of experience in this direction and who will welcome the exposition of methods developed elsewhere and under differing conditions.

The book, which is splendidly indexed, contains 167 pages, and is excellently illustrated, some of the microphotographs having come out exceptionally well.

Stainless Iron and Steel. By J. H. G. Monypenny. Published by Chapman and Hall, 11, Henrietta Street, Covent Garden, London, W.C.2. Price 21s. net.

This excellent work must now be regarded as the standard work on the subject of what are popularly known as stainless steels. The author has had the advantage of having the discoverer of the material, Mr. Harry Brearley, as a colleague for many years. Whilst a certain amount of controversy still exists as to whom the credit should be given for the origination of the material, we feel sure that the statement, as set out in the first chapter—Introductory and History—represents the true position of the case.

The real lesson of Chapter II—The Influence of Chromium on the Structure and Hardness of Steel—is that the pearlite contains slightly more than 0.30 per cent. instead of 0.9 per cent., the amount to be associated with plain carbon steels. A realisation of this factor renders easier an appreciation of the necessity for low-carbon stainless steel, and the differentiation between that material and stainless iron. This chapter is profusely illustrated with excellent microphotographs. We believe that these refer to worked material, but it is not at all clear from the text whether they refer to this form or the "as cast." We emphasise this, as the majority of our readers are more familiar with the latter condition.

Chapter III is devoted to the manufacture, working and treatment of stainless steel, the weak part in an otherwise masterly chapter is the section on manufacture. No real working details, such as costs and technical data, are given. The reviewer, for instance, when attempting in foreign steel works to make stainless steel from ordinary scrap and high carbon ferro chrome discovered an equilibrium at 0.5 per cent. carbon in the bath associated with a viscous slag. On thinning the slag to render it workable, parallel conditions were soon after established, and only by casting and remelting the resultant scrap was success attained. Other people must have experienced similar difficulties is obvious from the fact that experimental evidence favours the utilisation of chromite instead of cheap high-carbon ferro-chrome.

Chapter IV—Mechanical and Physical Properties of Stainless Steel—contains just the type of information we should like to have seen given in connection with the manufacture. Numerous data are presented which is very helpful in getting this wonderful range of alloys into the correct perspective.

The section devoted to the resistance to corrosion of stainless steel is, from the engineer's point of view of basic importance, especially when taken in conjunction with the previous chapter. This is emphasised, for example, when dealing with the effect of silicon, which is deleterious in quantity from the mechanical and neutral from the corrosion point of view.

Chapter VI is really a continuation of the previous chapter, but treated from a different angle, and in Chapter VII the author presents a statement as to the present metallurgical position of material, using the caption, "Special Stainless Steels."

The final chapter deals with some of the applications of stainless steel. Foundrymen will not appreciate the indisputable fact that "stainless steel valves and seats may be machined from forgings or drop stampings or from a rolled bar: either of these methods is preferable to that of using castings. The latter are likely to be less sound than the forged or rolled article, a feature common to all castings, and are therefore much more prone to develop flaws in service." From a foundry point of view, the only complaint we have to make, is that no real amount of space is devoted to either the present position or commercial prospects of stainless castings. Is stainless steel capable of competing commercially with manganese bronze for propeller blades?; is it likely to replace the large numbers of plated malleable castings absorbed in industry? These and other questions are of real interest to the foundry industry. However, despite the general absence of foundry aspect of stainless steel, we can confidently recommend a study of this book by our readers, leaving it to them to apply the tenets to their own particular requirements and manufactures.

As an appendix, the text of Mr. Brearley's Canadian and American Patents are given. The book contains 304 pages, and 109 illustrations and diagrams. It is well indexed, but lacks a bibliography on the subject.

Superannuation Schemes and Methods of Making Provision for Dependents of Employees. Published by the Industrial Welfare Society, of 51, Palace Street, Westminster, S.W.1. Price 2s. 6d.

In this useful publication the objects and elementary principles of pension funds are discussed, and definite schemes, with examples, are set out in detail. We strongly urge all foundry owners to study this book before taking any other steps to inaugurate a scheme.

Removing Screws.

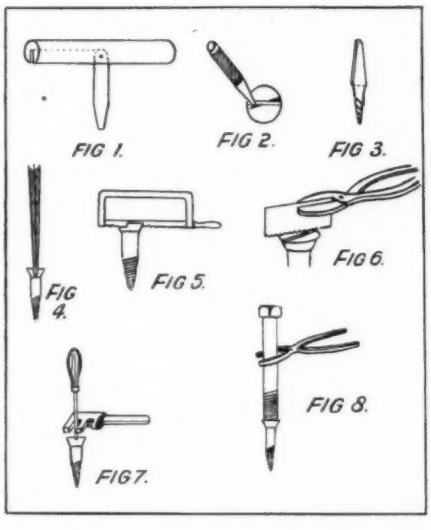
By James Edgar.

The moulder, when he cannot get a screw out, sends for the patternmaker who comes along with his brace, or a screw-driver about 3 ft. long. The moulder's driver is invariably small—the blade may not be more than a few inches—but the use he makes of it is wonderful; in awkward corners in a large mould where there is no room to wield a large screw-driver he will remove screws with apparent ease that would baffle a patternmaker.

In some patternshops, screws are precious things and insistence is made on the use of old screws wherever possible. The result of this is very often that time is wasted looking for suitable screws and frequently screws are used with slots badly worn. When it is necessary to remove such screws much time is wasted and at times the pattern suffers.

There is no harm in using old screws if they are not badly worn, but both new and old screws should be well greased. There is always a certain amount of moisture in timber which rusts an ungreased screw and renders it difficult to remove it, and insistence should in all patternshops be made on screws being well greased.

In repair shops especially it is necessary to have two or three short, stiff screw-drivers which



fit into the brace, since the combination allows of putting heavy pressure on the screw-driver, while at the same time it is short and stiff enough to stand the heavy leverage exerted by the brace. Another excellent type is the short, stiff screw-driver with a handle which can be turned cross-ways when desired so as to give better leverage in turning. This type is sometimes called the hammer screw-driver because the smooth end of the handle can be used as a light hammer when turned crossways. This is shown at Fig. 1. There are many variations of this screw-driver but the type shown is probably the best.

It is not uncommon when a screw has become rusted in for it to break below the surface when pressure is put on the screw-driver. A screw broken off thus may sometimes be backed out by setting a small punch against a corner as at Fig. 2 and tapping it with a light hammer in such a way as to turn it in the backward direction, but very often this only results in spoiling the slot and is seldom effective in raising the screw. A good way to remove such a screw is to make a centre with a centre punch, drill down a short distance with a small drill, and then force it lightly with the proper size of an Ezyout tool, Fig. 3. This is a tapered hardened tool with a left-hand twist, and fits into a brace. As the brace is turned backwards, the left-hand twist crowds the tapered tool tighter into the drill hole and usually the screw can be turned out easily. If such a tool is not available, a three-cornered file or other hardened tool can sometimes be forced into the drilled hole (Fig. 4), and then turned with a wrench or pair of pliers. The writer has usually found this latter method quite effective.

A method sometimes recommended, but which the writer is not enthusiastic about, because it can seldom be done without injuring the pattern, is, when the slot is badly damaged, to cut it down a little deeper with a hack saw (Fig. 5). If the head does not project enough to permit using a hack-saw, the slot can sometimes be dressed out and cut deeper by breaking off a piece of hack-saw blade a little shorter than the length of the slot, then holding this with a pair of pliers or a clamp, and moving it back and forth like a saw (Fig. 6). It is not a very practical method.

When a screw is stubborn the most common thing to do first is to set a square-ended punch or bolt on the screw head and give it a slight tap with a hammer. This may tend to drive the screw in deeper, but the important thing is to break or loosen the contact the screw head has with the wood, as often when this is done the screw can be turned out easily. Use a short screw-driver, the shorter the better, held in a brace, if available, alternatively hold an ordinary screw-driver blade firmly in the screw slot (Fig. 7), push down hard, and at the same time turn the screw-driver shank with a pair of pliers or a small wrench, so as to get better turning purchase. Sometimes turning the screw in slightly loosens it more quickly than trying to unscrew it at first.

A quite effective method is to hold a red-hot rod against the screw head until the screw is well heated, then place a cold screw-driver against the screw head, and immediately try to unscrew it (Fig. 8). Care has to be exercised, of course, to prevent the pattern being injured.

Many people try to remove screws with round heads or which project slightly by catching the heads with a pair of pliers and trying to turn them in that way, but this seldom, if ever, is successful, and simply chews up the screw and makes the final removal much more difficult. Where the head is broken off it is often difficult to remove the screw by ordinary means. Or the projecting screw may possibly be grasped and turned with a pair of pliers. Or two sides may be filed flat and the screw caught with pliers or a small wrench.

It is very seldom that it is found impossible to remove a screw without injuring the pattern, although we have at times found it necessary to bore a screw out using a large shell.

A Special Etching Reagent for Silicon in Iron.

In several series of experiments* carried on with iron containing oxygen deoxidised with the aid of silicon the samples were etched with iodine solution. This procedure resulted in revealing small etching-holes regularly distributed across some parts of the sample. It is interesting to note that the holes only cover the top part of the sample when the silicon content is 0.2 per cent., spreading regularly to the bottom part when the silicon content is increased. In the sample containing 1.8 per cent. of silicon the etching-holes cover the whole area of the etched surface. This fact may prove that the silicon does not diffuse into the iron so fast as it is generally assumed. As the experiments were carried on *in vacuo* the molten iron could not be stirred up, but it was kept at 1,600 deg. C. for seven minutes after the silicon had been added. The attempt of checking the results by etching a sample containing no oxygen failed, as the oxygen content could not be diminished but as much as 0.05 per cent. The etching reagent is an alcoholic solution of 1:10 of a $\frac{n}{10}$ iodine solution. The etching time is 5 to 15 minutes. Sometimes the effect is improved by slightly repolishing the section after etching.

Considerable damage was done by a fire last week at the works of Redfern & Stevens, Limited, drop stampers and machinists, of Alma Street, Aston.

* P. Oberhoffer, Stahl und Eisen, 1926, No. 35, page 1191.

Trade Talk.

THE NORTH BRITISH LOCOMOTIVE COMPANY, LIMITED, have an order to supply twelve superheater tank locomotives for the Madras and Southern Mahratta Railway.

THE ENGINEERS for the Shanghai Municipality Electricity undertaking have placed a contract with International Combustion, Limited, for "Lopulco" apparatus in connection with the extensions which are now proceeding at the Riverside Power Station, Shanghai.

THE BUSINESS of Granger Harrison & Company, iron ore merchants, 65, Gracechurch Street, London, E.C.3, is now being carried on under the joint management of Mr. R. N. Jackson (Lambert Brothers) and Mr. A. A. F. Lengo. It will be remembered that Mr. B. Granger Harrison died recently.

CHARGED under the Factory and Workshops Act at Sheffield, four summonses were brought against Pickford, Evans & Company, Limited, engineers and toolmakers, of 264, Ecclesall Road, Sheffield, relating to a milling machine in their Ecclesall Road factory. The charges were that certain pieces of machinery were not properly guarded. The firm were fined £10 and costs on one charge and £1 each on two others.

WE UNDERSTAND that the Admiralty have leased for a term of years a portion of Pembroke Dockyard to Messrs. Thos. W. Ward, Limited, of Sheffield. This is in accordance with the Government policy of assisting workmen who are thrown out of employment by the closing down of the dockyard at Pembroke, and indicates that the well-known ship dismantling firm has acquired some of the tonnage which was recently offered by the Admiralty on the understanding that preference would be given to firms that could absorb ex-dockyard labour.

THE BIRMINGHAM CHAMBER OF COMMERCE, which is responsible for the organisation and control of the Birmingham and Midland Section of the British Industries Fair, is enlarging the Exhibition buildings at Castle Bromwich. It is proposed to widen each of the three exhibition halls by 73 ft. Hall A has a length of 360 ft., and halls B and C a combined length of 620 ft. At the present time the halls have a total letting space of 85,000 ft., but when the extension is made this space will be increased to 125,000 ft. We understand that 90,000 ft. of space has already been let to 400 exhibitors.

SPEAKING on the Steel Workers' resolution at the Trades Union Congress at Bournemouth, Mr. T. Meehan, Middlesbrough section of the Iron and Steel Trades Confederation, said heavy iron and steel areas like Middlesbrough and Tees-side, since 1921, had been almost like cities of the dead. The industry had suffered more than any other industry, and they were compelled to ask Congress to assist them to get immediate relief. They said that under present conditions, particularly in view of the operation of finance capital, which was superseding the power of industrial capitalism, the workers in the industry would be compelled to do something like that suggested in the resolution. Last year, 2¾ million tons of steel were imported. If that steel had been manufactured here, it would have required 12 million tons of coal to produce, and the effect of that upon the iron and steel workers would have been beyond calculation.

Iron and Steel Production.

The National Federation of Iron and Steel Manufacturers in their Statistical Bulletin for July state that owing to the continuance of the coal stoppage the number of furnaces in operation, which had been 147 at the end of April, had fallen to 23 by the end of May, and to 11 by the end of June, still further fell to 8 by the end of July, and the production of pig-iron, which had reached 539,100 tons in April, amounted only to 17,900 tons in July. The production of steel ingots and castings, which in April had been 661,000 tons, amounted only to 32,100 tons in July.

Output in August.

The National Federation of Iron and Steel Manufacturers further report that, owing to the continuance of the coal stoppage, furnaces in blast have again declined, and at the end of August only six remained active, compared with 147 on the eve of the coal stoppage. Production of pig-iron, therefore, only amounted to 13,600 tons, compared with 17,900 tons in July, 539,100 tons in April, and a monthly average of 855,000 tons in 1913.

Production of steel ingots and castings in August totalled 52,100 tons, compared with 32,100 tons in July, 661,000 tons in April, and a monthly average of 638,600 tons in 1913.

Patent Specifications.

The following list of patent specifications accepted have been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full specification can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

9,627. HINES, J. F. Foundry flasks. (April 10, 1925.) 250,621.

17,319. MATHIESON ALKALI WORKS. Purification of iron. (April 10, 1925.) 250,522.

28,995. MOND, A. L. (Metallbank and Metallurgische Ges. Akt.-Ges.). Process for complete elimination of zinc from fine zinciferous ores. (Nov. 17, 1925.) 257,133.

397. CLOUWEZ, C. Apparatus for washing and classifying minerals. (Jan. 9, 1925.) 245,770.

8,059. STEELE, L. C. Manufacture of sheet metal. March 25, 1925. 257,299.

13,661. HARE, D. C. Treating ores. May 26, 1924. 234,524.

14,072. INTERNATIONAL NICKEL COMPANY. Separating nickel and copper from copper-nickel mattes. September 30, 1924. 240,789.

Contracts Open.

Hengoed, September 30.—Cast-iron goods, galvanised fencing wire, barbed and plain, ending September, 1927, for the Gellygaer Urban District. Mr. F. Read, surveyor, Council Offices, Hengoed.

London, S.E.1. September 28.—225 tons rolled steel joists, for the Director-General, India Store Department, Branch No. 14, Belvedere Road, Lambeth, S.E.1. (Fee 5s. per set, non-returnable.

Pontefract, September 27.—Cast-iron mains and specials, for the Pontefract Corp. Gasworks. Mr. B. Hudson, gas manager, Gasworks, Pontefract.

Portsmouth, October 1. — (U) Castings and machined parts, from October 1, 1926, to March 31, 1927, for the Tramways Committee. The General Manager and Engineer, Guildhall, Portsmouth.

Tynemouth, September 25.—Cast-iron work, iron pipes and fittings, iron and steel, files, bolts and nuts, for half-year ending March 30. 1927, for the Corporation. Mr. J. F. Smillie, borough surveyor, Tynemouth.

New Companies.

Andrew Robertson & Sons (Darwen), Limited, Lodge Bank Foundry, Taylor Street, Darwen.—Capital £2,000. Engineers and ironfounders. Directors: A., R. and A. (jun.) Robertson.

Carlton Pipe Joint Company, Limited, 2, Campo Lane, Sheffield.—Capital £10,000 in £1 shares, to acquire the business carried on by S. Gill, C. L. MacCarthy and R. W. Spencer as the Carlton Flexible Pipe Joint Company, at High Street, Sheffield. Secretary: F. Laister.

Jepson (Metals), Limited, 42-46, Whitecross Street, E.C.1.—Capital £6,000 in £1 shares.

Murray and Charleton, Limited, St. Mary's Place, Newcastle-on-Tyne.—Capital £15,000 in £1 shares (3,000 7 per cent. cumulative preference and 12,000 ordinary). Engineers.

Mexican Iron and Steel Industry in 1925.—About 46,000 metric tons of iron ore were mined in Mexico in 1925, according to information supplied by one of the principal steel companies in Mexico. The same authority states that 38,000 tons of pig-iron, 850 tons of steel castings, and about 4,500 tons of bolts, nuts, spikes, and rivets were manufactured, and the following materials were rolled: 9,800 tons of structural steel, 18,300 tons of commercial bars, and 8,900 tons of rails. At least two important companies have made large extensions in their equipment. Both companies made substantial additions to their bolt and nut factories. One has installed cold-working machinery —mostly purchased in Germany. The other company has ordered a complete plant for the manufacture of wood screws, is now installing a 6-ton Héroult electric furnace, and is also purchasing machinery in the United States for the equipment of a plant for the manufacture of railway, automobile, and wagon springs. The president of the latter Company also reports that great improvements were made during 1925 in the manufacture of high-grade and alloy steel, from which the Company is at present making all its tools, dies, and punches. This firm is now making all its products from electric steel, having discontinued its other processes. These iron and steel companies report a decided decrease in the demand for steel products from the oil-producing sections of Mexico, but an increased demand from mining and industrial centres.

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THE FOUNDRY TRADES EQUIPMENT & SUPPLIES ASSOCIATION LTD.

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—The prolongation of the existing difficult industrial conditions has necessarily had a corresponding adverse effect upon markets for pig-iron, which, now almost completely deprived of home supplies, have compulsorily to limit requirements, or become entirely dependent on foreign furnace resources. In the circumstances thus outlined, it may be counted as really remarkable that foundrymen have been able to maintain a fairly steady rate of production, and given an early settlement of the disastrous dispute in progress, there is little doubt of a speedy return to something like normal conditions. Until that much-to-be-desired object is achieved, consumers of the staple product are perforce compelled to await events, and buying in the Cleveland iron market meanwhile must remain lifeless, there being practically no output available except for October delivery, while there is an increasing demand for Continental No. 3, which can be bought at 72s. 6d. per ton f.o.b. Antwerp. But deliveries are subject to a good deal of delay, and prices are showing a stiffening tendency. Cleveland quotations now stand as follow:—No. 1, 96s.; No. 3 G.M.B., 93s. 6d.; No. 4 foundry, 92s. 6d.; and No. 4 forge, 92s. per ton.

Metals.

Copper.—The position of standard copper during the past week, although a shade easier towards the close, has disclosed little material change, and may still be regarded as distinctly steady at current values, especially as applied to cash metal. This is probably due more to the slight downward movement indicated in the American cables than to anything else, as there has been no material alteration in conditions in this country, either on the consumptive or speculative side. The fact that American consumers are providing for their requirements over the fourth quarter of the year should have a steadying influence, and the statistical position here is shaping towards a further improvement.

Official closing prices of standard copper have been as follow:—

Cash: Thursday, £58 10s. to £58 12s. 6d.; Friday, £58 15s. to £58 17s. 6d.; Monday, £58 15s. to £58 17s. 6d.; Tuesday, £58 15s. to £58 17s. 6d.; Wednesday, £58 7s. 6d. to £58 10s.

Three Months: Thursday, £59 7s. 6d. to £59 10s.; Friday, £59 10s. to £59 12s. 6d.; Monday, £59 10s. to £59 12s. 6d.; Tuesday, £59 10s. to £59 12s. 6d.; Wednesday, £59 5s. to £59 7s. 6d.

Tin.—During the past week movements in standard cash tin continued on the previously reported advancing scale, and a spectacular rise was again recorded. Based upon a sensational shrinkage in visible supplies contained in the August figures, the premium on new tin, which had previously been about £3 5s. a ton, has advanced rapidly to £11 a ton under an exceptionally keen demand. Further encroachments have been made on home stocks, which are returned at 1,678 tons, distributed equally between London and Liverpool.

Official closing prices of standard tin have been as under:—

Cash: Thursday, £316 10s. to £316 15s.; Friday, £313 10s. to £314; Monday, £312 to £312 10s.; Tuesday, £311 10s. to £312; Wednesday, £305 10s. to £305 15s.

Three Months: Thursday, £304 to £304 5s.; Friday, £303 to £303 10s.; Monday, £301 to £301 10s.; Tuesday, £302 to £302 5s.; Wednesday, £299 10s. to £299 12s. 6d.

Spelter.—Demand in this section of the markets has been on a rather diminished scale of late, but prices, on the whole, remain fairly steady. The present unsatisfactory conditions in the labour world undoubtedly check any transactions of importance being entered into, but the slight downward tendency of values noticeable recently has been more due to liquidation of surplus requirements than to anything else. A little more activity has been evidenced in the forward position, which accounts for the small premium asked.

The following are the week's prices:—

Ordinary: Thursday, £34 8s. 9d.; Friday, £34 11s. 3d.; Monday, £34 13s. 9d.; Tuesday, £34 12s. 6d.; Wednesday, £34 10s.

Lead.—The market for soft foreign pig has lately developed a more irregular tendency, but with some indications of a small upward movement in values. Probably the announcements regarding the increase in production of the metal had as much to do with the recent decline as anything.

The week's prices are appended:—

Soft foreign (prompt): Thursday, £32 15s.; Friday, £32 11s. 3d.; Monday, £32 8s. 9d.; Tuesday, £32 8s. 9d.; Wednesday, £31 18s. 9d.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
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Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

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J. GRAYSON LOWOOD & Co., Ltd.
DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

Sterling

THE POPULARITY OF STERLING BOXES

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Rolled Steel is the ideal material for making Moulding Boxes. By its means great strength can be obtained in the right place and to a degree impossible by any other mode of construction.
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STERLING FOUNDRY SPECIALTIES LTD.
BEDFORD

London Office: 13, VICTORIA STREET, S.W.1.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	58	7	6
Three months	59	5	0
Electrolytic	66	5	0
Tough	64	5	0
Best selected	64	15	0
Sheets	90	0	0
India	73	0	0
Wire bars	67	0	0
Do. October	66	10	0
Do. November	66	10	0
Ingot bars	66	10	0
H.C. wire rods	69	15	0
Off. av. cash, Aug.	58	18	4½
Do., 3 mths. Aug.	59	13	7½
Do., Sttlmnt, Aug.	58	17	7½
Do., Electro, Aug.	67	1	10½
Do., B.S., Aug.	66	0	10
Aver. spot price copper, Aug.	58	17	7½
Do., wire bars, Aug.	67	6	8
Solid drawn tubes			13d.
Brazed tubes			13d.
Wire			9¾d.

BRASS.

Solid drawn tubes	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g	10⅝d.
Wire	10½d.
Rolled metal	9⅞d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	305	10	0
Three months	299	10	0
English	304	0	0
Bars	312	15	0
Straits	319	15	0
Australian	—		
Eastern	308	10	0
Banca	—		
Off. avr. cash, Aug.	293	16	1½
Do., 3 mths., Aug.	282	2	3½
Do., Sttlmt. Aug.	293	14	6½
Aver. spot., Aug.	293	14	6½

SPELTER.

	£	s.	d.
Ordinary	34	10	0
Remelted	33	0	0
Hard	28	10	0
Electro 99.9	37	7	6
English	35	5	0
India	30	15	0
Zinc dust	43	0	0
Zinc ashes	16	0	0
Off. aver., Aug.	34	6	11½
Aver., spot, Aug.	34	3	5½

LEAD.

	£	s.	d.
Soft foreign ppt.	31	18	9
English	33	5	0
Off. average, Aug.	32	11	0½
Average spot, Aug.	32	15	1½

ZINC SHEETS, &c.

Zinc sheets, English	42	15	0
Do. V.M. ex whf.	39	15	0
Rods	45	0	0
Boiler plates	39	0	0
Battery plates	38	10	0

ANTIMONY.

Special brands, Eng.	74	10	0
Chinese	64	0	0
Crude	45	0	0

QUICKSILVER.

Quicksilver	15	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon 25%	9	2	6
45/50%	10	0	0
75%	17	2	6

Ferro-vanadium—
35/40% .. 14/6 lb. va.
Ferro-molybdenum—
70/75% c. free .. 5/3 lb.
Ferro-titanium—
23/25 % carbonless 11½d.

Ferro-phosphorus, 20/25%,	£16 10 0

Ferro-tungsten—
80/85%, c.fr. 1/4 to 1/4½ lb.
Tungsten metal powder—
98/99% 1/10 to 1/11 lb.
Ferro-chrome—

2/4% car.	£33	0	0
4/6% car.	£22	0	0
6/8% car.	£21	10	0
8/10% car.	£20	15	0

Ferro-chrome—

Max. 2% car.	£37	0	0
Max. 1% car.	£43	5	0
Max. 0.70% car.	£54	10	0

70%, carbonless 1/5 lb.
Nickel—99%, cubes or pellets .. £170
Cobalt metal—98/99% 10/- lb.
Aluminium 98/99% £112 to £118
Metallic Chromium—
96/98% .. 3/- lb.
Ferro-manganese (net)—

76/80%, loose	£14	0	0
76/80%, packed	£15	0	0
76/80%, export	£14	0	0

Metallic manganese—
94/96%, carbonless 2/- lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	2	6
Finished bars, 18% tungsten	3	0

Per lb. net, d/d buyers' works.
Extras—
Rounds and squares 3 in. and over .. 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Do. under ¼in. to ⅛ in. .. .. 1/- lb.
Flats, ½in. × ½in. to under 1 in. × ⅛ in. 3d. lb.
Do. under ½in. × ½in. 1/- lb
Bevels of approved sizes and sections 6d. lb.
Bars cut to length 10% extra
Scrap from high-speed tool steel—
Scrap pieces .. .. 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—£ s. d. £ s. d.
Hvy. steel 2 5 0 to 2 10 0
Bundled steel & shrngs. 2 0 0 to 2 5 0
Mixed iron & steel 2 2 6
Heavy cast iron 2 15 0 to 3 0 0
Good machinery for foundries .. 3 5 0
Cleveland—
Heavy steel .. 3 2 6
Steel turnings .. 2 7 6
Cast iron borings 2 5 0
Heavy forge .. 4 2 6
Bushelled scrap 3 10 0
Cast-iron scrap 3 8 0 to 3 10 0
Lancashire—
Cast-iron scrap 3 2 6 to 3 10 0
Hvy. wrought .. 3 2 6
Steel turnings .. 2 2 0
London — Merchants' buying prices delivered yard.

Copper (clean) ..	49	0	0
Brass (clean) ..	39	0	0
Lead (less usual draft)	28	10	0
Tea lead ..	23	10	0
Zinc	23	0	0
New aluminium cuttings ..	78	0	0
Braziery copper	45	0	0
Gunmetal ..	46	0	0
Hollow pewter	195	0	0
Shaped black pewter ..	144	0	0

PIG-IRON.

(*f.o.t. unless otherwise stated*).
N.E. Coast—

Foundry No. 1 ..	96/-
Foundry No. 3 ..	93 6
Foundry No. 4 ..	92 6
Forge No. 4	92/-
Hematite No. 1 ..	83/6
Hematite M/Nos. ..	83/-

N.W. Coast—

Hem. M/Nos. d/d Glas.	88/6
„ d/d Birm.	106/-

Midlands—

Staffs common* ..	—
„ No. 4 forge ..	—
„ No. 3 foundry	—
Shrops. basic	—
„ Cold blast, ord.*	—
„ „ roll iron* ..	—

* d/d Birmingham.

Northants forge	—
„ fdry No. 3 ..	—
Derbyshire forge ..	—
„ fdry. No. 3 ..	—
„ basic	—

Scotland—

Foundry No. 1 ..	—
„ No. 3 90/- to	92/6
Hem. M/Nos.	82/6

Sheffield (d/d district)—

Derby forge	—
„ fdry. No. 3 ..	—
Lincs. forge	—
„ fdry. No. 3 ..	—
E.C. hematite	95/-
W.C. hematite ..	95/-

Lincs. (at furnaces)—

Forge No. 4	—
Foundry No. 3. ..	—
Basic	—

Lancashire (d/d eq. Man.)—

Derby forge	—
„ fdry. No. 2 ..	—
Northants foundry No. 3	—
Dalzell, No. 3	110/-
Summerlee, No. 3 ..	107/6
Glengarnock, No. 3 ..	107/6
Gartsherrie, No. 3 ..	107/6
Monkland No 3	107/6
Coltness, No. 3	107/6
Shotts, No. 3	107/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom. ..	11	10	0 to	13	10	0
Angles				12	0	0
Tees to 3 united ins.				12	10	0
Nut and bolt iron				—		
Hoops				14	10	0
Marked bars (Staffs.) f.o.t. ..				14	0	0
Gas strip				12	10	0
Bolts and nuts .. ¾ in. × 4 in. ..				15	5	0
Steel—						
Ship plates				8	2	6
Boiler plts. ..				11	5	0
Chequer plts. ..				9	10	0
Angles ..	7	7	6 to	7	10	0
Tees ..	8	7	6 to	8	10	0
Joists ..	7	7	6 to	7	10	0
Rounds and Squares 3 in. to 5½ ins. ..				9	0	0
Rounds under 3 in. to ⅜ in.				8	12	6
Flats, over 5 in. wide and up ..				9	10	0
Flats, 5in. to 1½in.				8	10	0
Rails, heavy ..				8	10	0
Fishplates				12	10	0
Hoops (Staffs.) ..				10	10	0
Black sheets, 24g.				11	5	0
Galv. cor. sheets, 24g.				16	15	0
Galv. fencing wire 8g. plain				12	10	0
Billets, soft ..				—		
Billets, hard ..				8	2	6
Sheet bars				—		
Tin bars d/d ..				7	0	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	4
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

Per lb.
Ingots for raising 9d. to 1/3
Rolled—
To 9 in. wide 1/3 to 1/9
To 12 in. wide 1/3½ to 1/9½
To 15 in. wide 1/3½ to 1/9½
To 18 in. wide 1/4 to 1/10
To 21 in. wide 1/4½ to 1/10½
To 25 in. wide 1/5 to 1/11
Ingots for spoons and forks .. 9d. to 1/5½
Ingots rolled to spoon size .. 1/- to 1/8½
Wire round—
3/0 to 10 G. 1/6½ to 2/1½
with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated. Dols.

No. 2X foundry, Phila.	21.76
No. 2 foundry, Valley	19.26
No. 2 foundry, Birm.	21.00
Basic	19.26
Bessemer	19.76
Malleable	19.26
Grey forge	18.76
Ferro-mang. 80% d/d	88.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00

Cents.

Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 28 ..	3.15
Sheets, galv., No. 28 ..	4.25
Sheets, blue an'l'd, 9 & 10	2.30
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry	—
„ furnace	—
Durham & North.	
„ foundry	—
„ furnace	47/6
Other Districts, foundry	—
„ „ furnace (basis)	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	23/-
„	28×20, „	46/-
„	20×10, „	—
„	18¾×14, „	—
C.W.	20×14, „	—
„	28×20, „	—
„	20×10, „	—
„	18¾×14, „	—

Terneplates 28×20, — per box basis f.o.b.

SWEDISH IRON.

Bars, hammered £18/10 to £19/0
Rolled Ord. £15/10/0 to £16
Nail rods £16 5 0 to £16 15 0
Keg. steel nom. £33 to £35
Faggot steel nom. £22 to £25
Blooms, according to quality £9 to £12
Pig-iron £6 0 0 to £6 10 0 all f.o.b. Gothenburg.

TUBES AND FITTINGS.
Up to and incl. 6 in.

	Tubes	*Fittings*
Gas ..	60% ..	50%
Water ..	55% ..	45%
Steam ..	50% ..	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Sept. 16	58	10	0	dec. 5/-
,, 17	58	15	0	inc. 5/-
,, 20	58	15	0	No change
,, 21	58	15	0	,, ,,
,, 22	58	7	6	dec. 7 6

Electrolytic Copper.

	£	s.	d.	
Sept. 16	66	10	0	dec. 5/-
,, 17	66	10	0	No change
,, 20	66	10	0	,, ,,
,, 21	66	10	0	,, ,,
,, 22	66	5	0	dec. 5/-

Standard Tin (Cash).

	£	s.	d.	
Sept. 16	316	10	0	inc. 120/-
,, 17	313	10	0	dec. 60/-
,, 20	312	0	0	,, 30/-
,, 21	311	10	0	,, 10/-
,, 22	305	10	0	,, 120/-

Tin (English ingots).

	£	s.	d.	
Sept. 16	315	10	0	inc. 130/-
,, 17	312	10	0	dec. 60/-
,, 20	311	0	0	,, 30/-
,, 21	310	15	0	,, 5/-
,, 22	304	0	0	,, 135/-

Zinc Sheets (English).

	£	s.	d.	
Sept. 16	42	15	0	No change
,, 17	42	15	0	,, ,,
,, 20	42	15	0	,, ,,
,, 21	42	15	0	,, ,,
,, 22	42	15	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Sept. 16	34	8	9	inc. 3 9
,, 17	34	11	3	,, 2/6
,, 20	34	13	9	,, 2/6
,, 21	34	12	6	dec. 1/3
,, 22	34	10	0	,, 2/6

Lead (English).

	£	s.	d.	
Sept. 16	33	15	0	inc. 10/-
,, 17	33	10	0	dec. 5/-
,, 20	33	10	0	No change
,, 21	33	10	0	,, ,,
,, 22	33	5	0	dec. 5/-

Exports of Iron Castings in August and the eight months 1926, compared with August and the eight months 1925.

	August, 1925.	August, 1926.	Eight months, 1925.	Eight months, 1926.	August, 1925.	August, 1926.	Eight months, 1925.	Eight months, 1926.
BUILDERS' CASTINGS—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers—								
To Argentine Republic	167	145	1,044	928	5,899	6,289	38,534	39,386
,, British South Africa	221	416	2,456	2,912	7,430	14,019	86,633	99,131
,, ,, East Indies	174	124	1,181	1,172	7,295	5,357	54,543	51,706
,, Australia	72	35	483	592	4,617	1,982	27,214	32,833
,, New Zealand	269	180	1,869	1,539	11,529	8,720	86,199	74,318
,, Other countries	641	645	5,104	5,327	30,993	31,734	257,712	253,834
Total	1,544	1,545	12,137	12,470	67,763	68,101	550,835	551,208
PIPES AND FITTINGS—CAST—								
To Argentine Republic	1,406	461	8,402	5,617	17,873	5,381	107,167	69,624
,, British South Africa	332	371	4,855	5,428	5,866	5,906	68,791	72,970
,, ,, India	571	318	6,754	6,050	8,152	4,433	95,570	76,318
,, Straits Settlements and Malay States	243	1,930	4,224	12,726	3,169	15,860	50,292	107,711
,, Ceylon	49	130	901	1,529	776	1,962	11,315	17,293
,, Australia	93	98	2,229	3,033	1,606	1,763	35,220	40,070
Other countries	4,768	3,064	37,640	33,370	63,752	47,548	552,463	460,258
Total	7,462	6,372	65,005	67,753	101,194	82,853	920,818	844,244
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned ..	638	443	5,466	4,523	20,461	16,976	183,062	159,319
,, Enamelled	66	94	679	635	8,481	9,390	69,850	66,923
CASTINGS, in the rough—								
Iron	198	75	1,070	1,052	4,637	2,193	37,202	29,207
Steel	40	37	474	523	2,087	1,362	19,415	15,367

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

18, BENNETTS HILL, BIRMINGHAM.
11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

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LIMPET

1, HONG KONG ROAD, SHANGHAI.
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JAVA STREET, KUALA LUMPUR
5, SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.
P.O. BOX 1580, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

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Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 7 words per line. Minimum charge for one insertion 3/-.

SITUATIONS VACANT AND WANTED.

ADVERTISER, progressive organiser, with long practical experience of Foundry, Pattern Shop and general Engineering, desires management of small works, or responsible position with larger firm.—Replies to Box 790, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ADVERTISER desires change; 22 years' experience foundry pattern shop, also machine shop, as Foreman, Draughtsman, Checker, and Chief Inspector; alive to modern methods of mass production, chiefly aluminium and iron motor cylinders.—Box 802, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY FOREMAN required in a Foundry at present melting about 10 tons per day; must have experience on good-class jobbing work up to 10 to 15 cwt., also light plate and machine work, power machines, pipes, etc.—Apply, giving full particulars of experience, age and salary required, to Box 810, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand London, W.C.2.

PARTNERSHIPS.

A WELL-ESTABLISHED FIRM of Government Contractors, manufacturing by up-to-date processes a complete range of highly efficient and very economic abrasive tools which are meeting with rapidly increasing success in Iron and Steel Foundries, Railways, Engineering and Motor Works, Shipyards, etc., offers a Directorship to a gentleman intimately connected with some of the largest users. Owing to the extension of works becoming necessary investment up to £25,000 would be considered.—Box 264, ENTREPRENEURS, LIMITED, 7, Queen Street, E.C.4.

AGENCIES.

AGENTS WANTED all districts for sale of Foundry Plumbago and Charcoal Blacking on commission basis; must have connection.—Box 808, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

PNEUMATIC HAMMER, 5-cwt., by Peter Pilkington, Limited, belt driven, with 2 ft. dia. W.I. pulleys, 5¼ in. face, all on solid C.I. base; in excellent condition; £150.—G. SCAMMELL & NEPHEW, LIMITED, Fashion Street, Spitalfields, E.1.

SMALL Cupola, complete with fan; brick lined; little used; capacity about 5 cwt. per hour; £25. Also 2½-h.p. National Gas Engine, magneto or tube ignition, with bag, tank and fittings; guaranteed excellent condition; seen running; £18.—VINELL & SON, Engineers, Tonbridge.

PATENTS.

PATENT YOUR INVENTIONS, Trade-mark your Goods. Advice, Handbook and Cons. free.—B. T. KING, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.). 146A, Queen Victoria Street, E.C.4. 38 years' refs. 'Phone 682 Central.

PATENTS AND DESIGNS ACTS, 1907 and 1919.

THE Proprietor of British Patent No. 171,080 is prepared to sell the Patent or to licence British Manufacturers to work thereunder. It relates to a furnace for heating sheet and tinplate bars, slabs or billets.—Address, B. W. & T., 112, Hatton Garden, London, E.C.1.

PUBLICATION.

IRON, STEEL, BRASS AND ALUMINIUM FOUNDERS, MANUFACTURING ENGINEERS, MAKERS OF FOUNDRY PLANT AND REQUISITES, REFRACTORIES.

The 1926 Edition of "RYLANDS," now on sale, covers all branches of these industries, in addition to many others. Order your Copy now. Price 42s. cloth, 52s. morocco. INDUSTRIAL NEWSPAPERS, LTD., 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS.

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